University of Phoenix Sci256 Week 2 material Ecosystems

Ch 5,6,9,10
Ecosystems and Energy,
Ecosystems and Living Organisms,
Ecosystems and the Physical Environment,
Major Ecosystems of the World,
Controlling Pests

The syllabus for week 3

- Read Ch 11-14 & 17-20
- Learning Team Paper – Natural Resources and Energy Paper
- 1,400-1,750 word paper
- Four main points to cover
- 2 outside references
- APA guidelines!

Ecosystems, Biogeochemicals, Energy, and Trophic Pyramids

Chapter 5 (and chap. 9 combined)

"Mom, where are we on the food chain?"

Ecosystems And Energy

Energy

- Laws of Thermodynamics
- Photosynthesis/Respiration

Trophic Pyramids

Energy Flow

Food Webs

Productivity

Ecology

= The study of relationships between organisms and their environment.

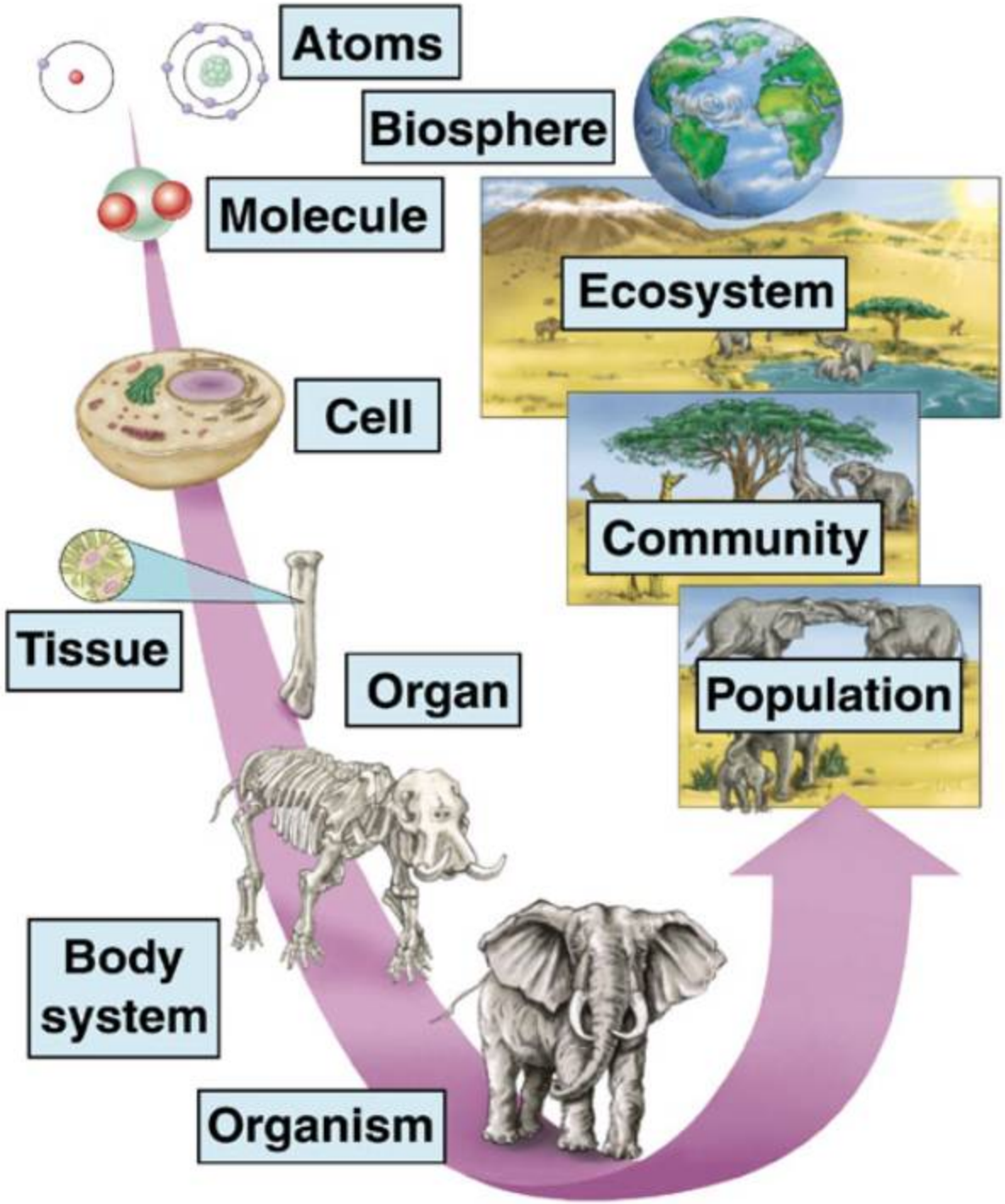
Environment = biotic and abiotic factors that affect an organism during its lifetime.

Abiotic factors: nonliving parts of the environment - **water, minerals, sunlight, climate.**

Biotic factors: organisms that are a part of the environment

Stand and Deliver

- Nearby (Colorado or your home) biotic components?
- Nearby abiotic components?

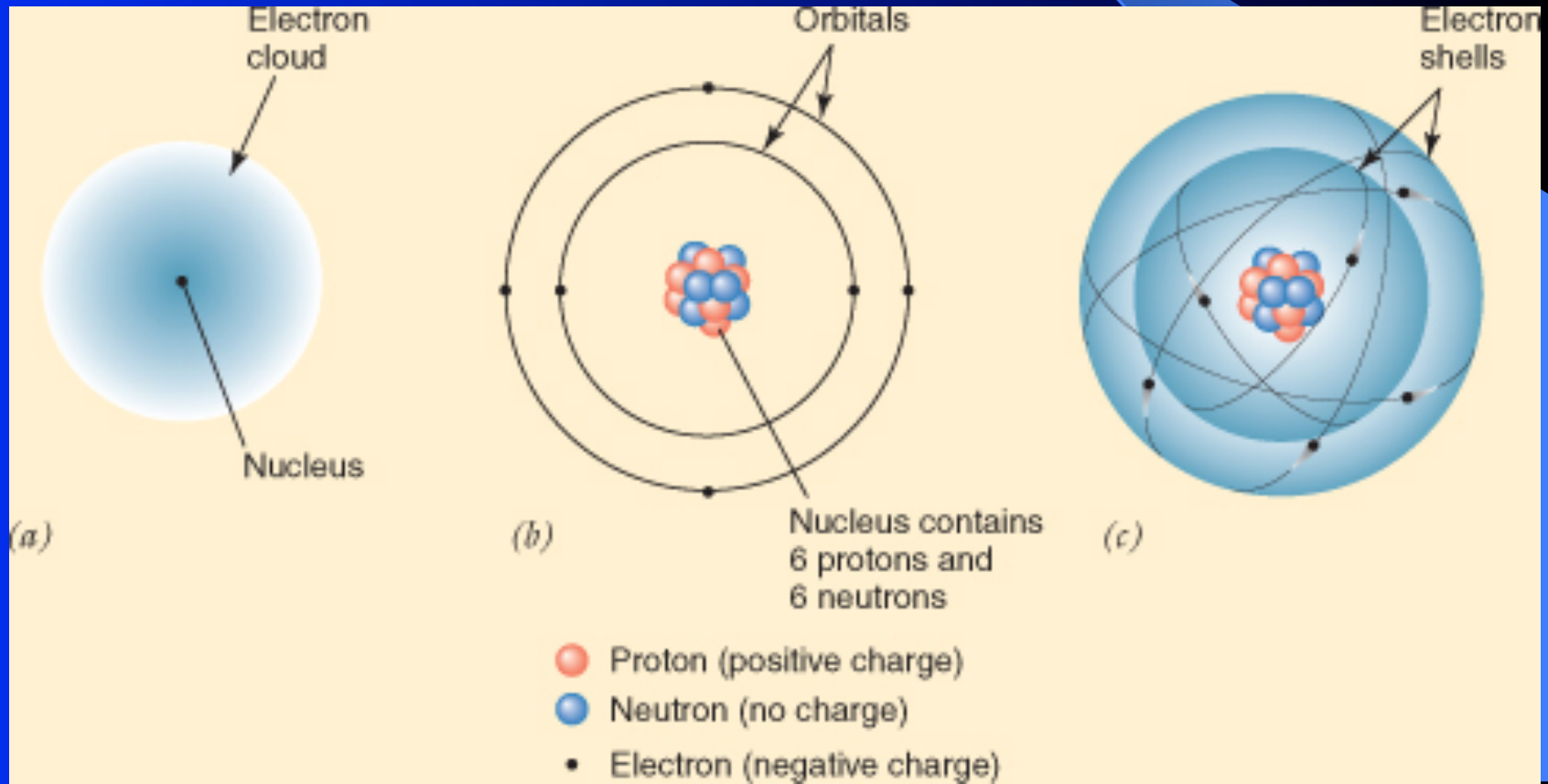

Atoms
Biosphere
Molecule
Ecosystem
Cell
Community
Tissue
Organ
Population
Body system
Organism

What is a Biogeochemical?

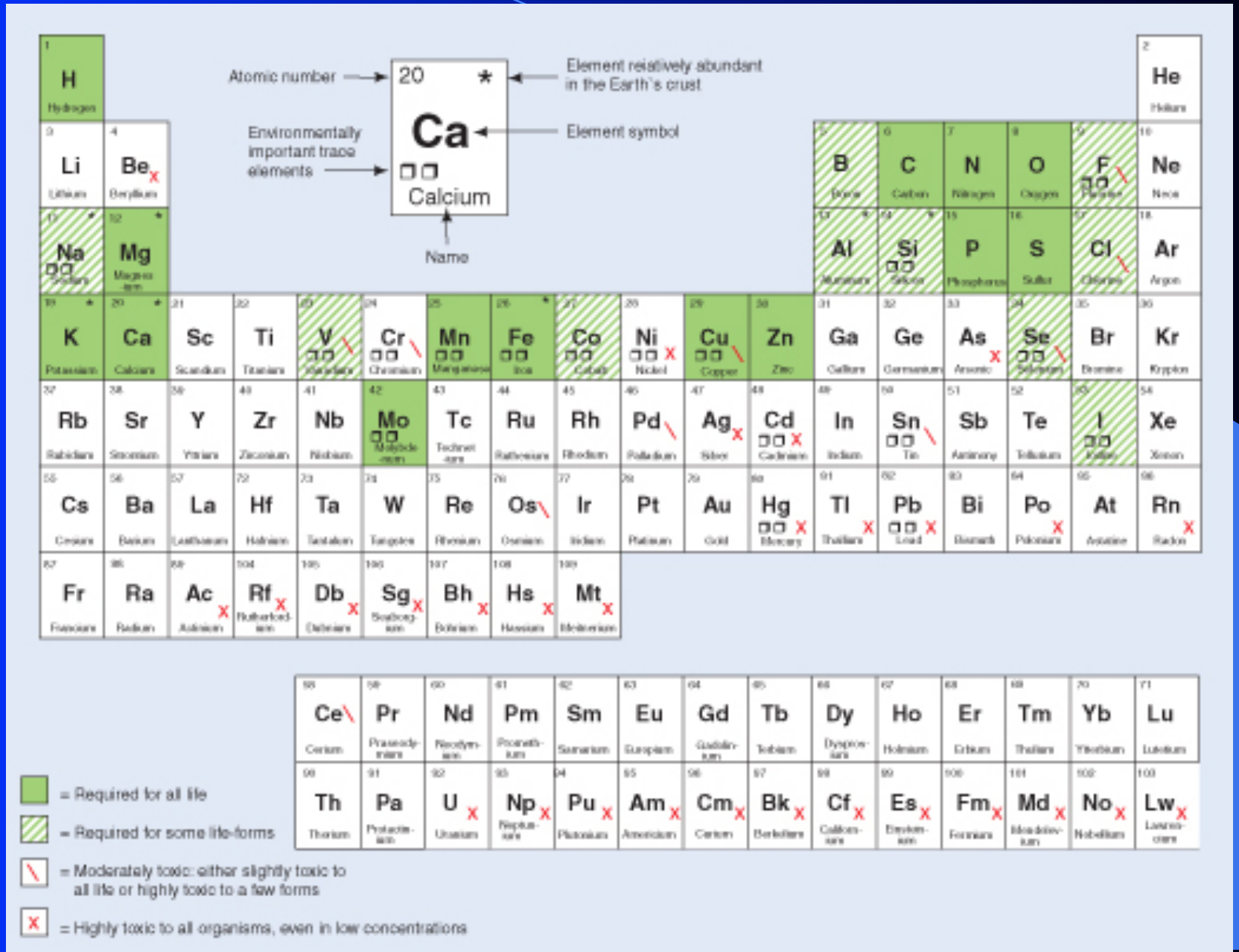
- Bio = life
- Geo = earth
- Chemical = chemical
- Chemicals that comes from the earth needed for life!

What a chemical is

- An atom or collection of atoms (molecules)

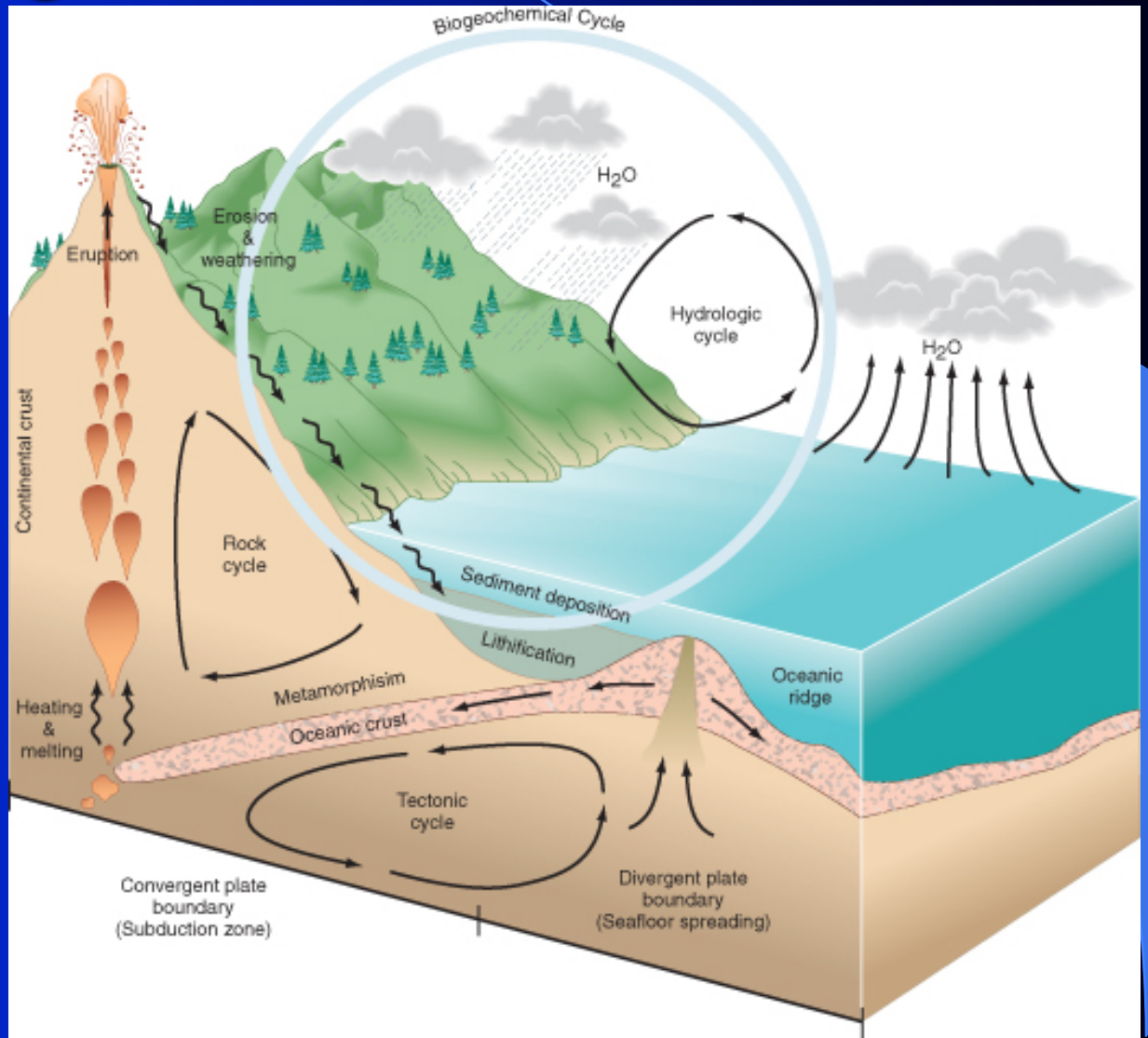


Chemicals of Life



Moving chemicals around…

- What moves them?



Energy

Laws of Thermodynamics

First Law (Conservation of Energy)

Energy is neither created nor destroyed; it is always conserved.

Second Law

Energy always tends to go from a more usable form to a less usable form, so the amount of energy available to do work decreases (entropy occurs).

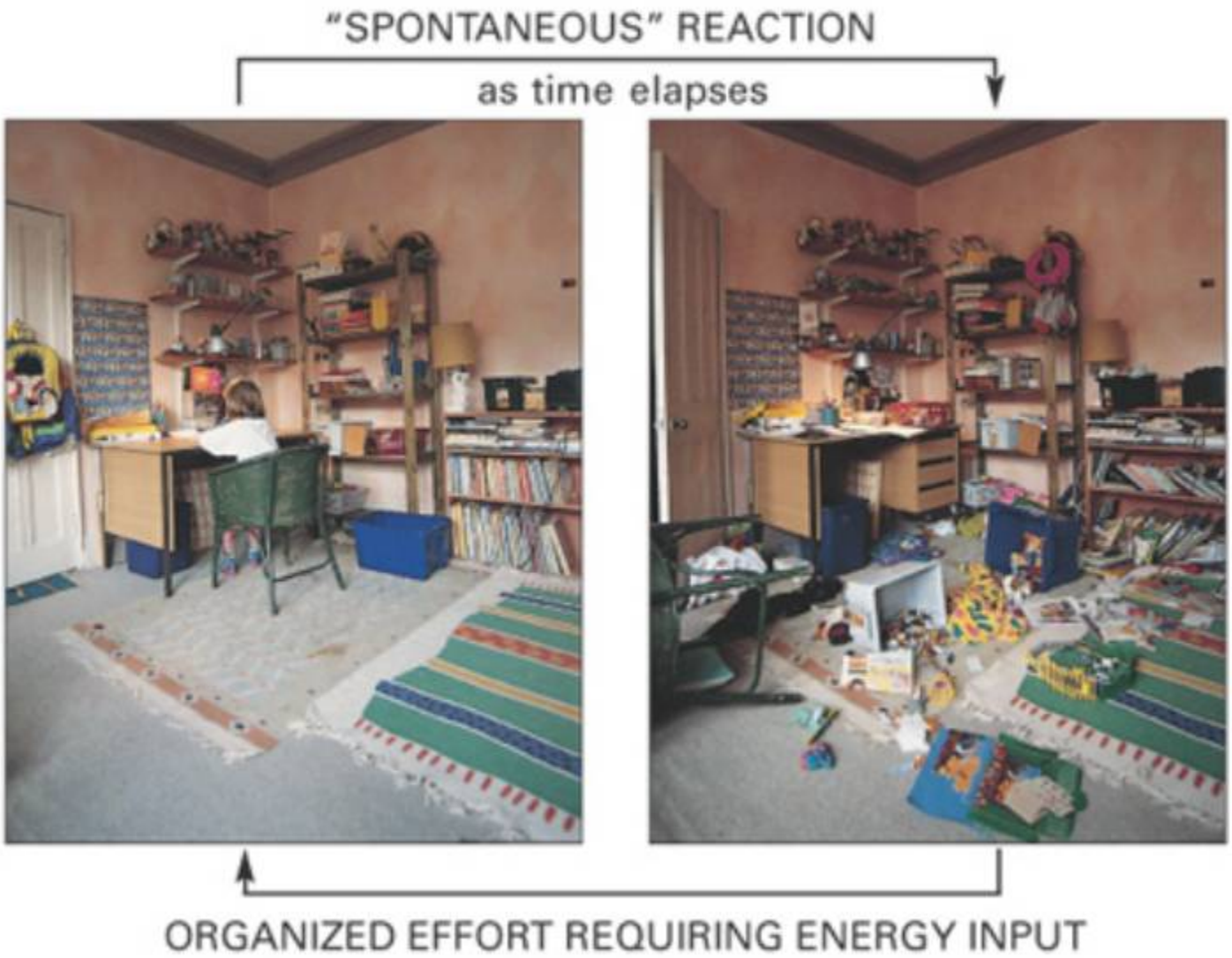


Figure 3-5 Essential Cell Biology, 2/e. (© 2004 Garland Science)

Consequence Of Laws Of Thermodynamics For Living Organisms

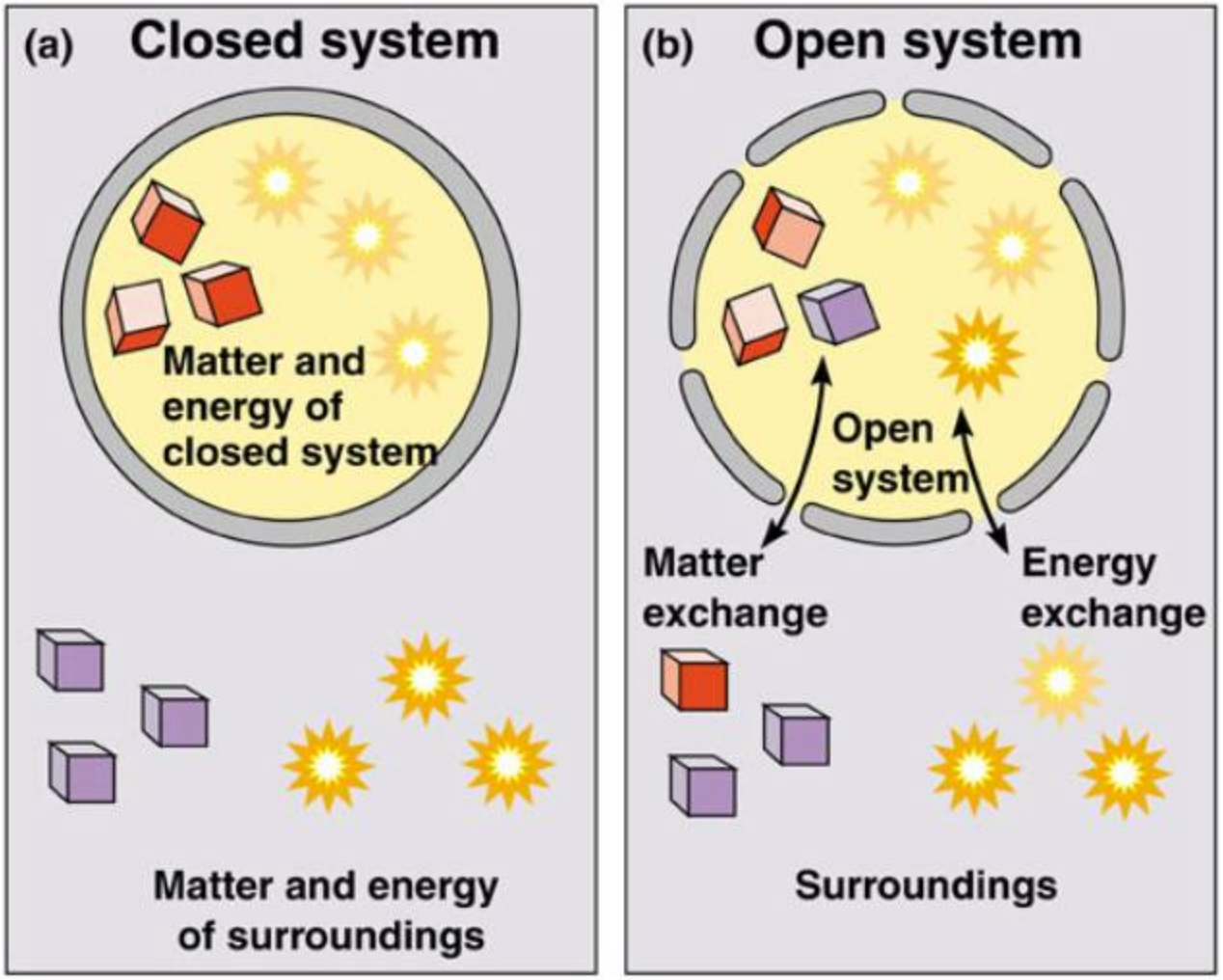
Organisms require a constant input of energy to maintain a high level of organization.

"Feed Me Seymour!" – Little Shop of Horrors

This Slide is Yellow

Types of Energy Systems

Raven/Berg, Environment, 3/e
Figure 4.4



Photosynthesis
(Transformation of Light Energy)

$$6\ CO_2 + 12\ H_2O + \text{radiant energy}$$

$$\downarrow$$

$$C_6H_{12}O_6 + 6\ H_2O + 6\ O_2$$

Stores energy in chemical bonds

Respiration
(Transformation of Chemical Energy)

$$C_6H_{12}O_6 + 6\ H_2O + 6\ O_2$$

$$\rightarrow$$

$$6\ CO_2 + 12\ H_2O + \text{energy}$$

Provides energy for "work"

Ecological Studies Show How the Whole System Works.

Focus:

1. The roles played by members of a community

2. The energy/resource structure of the system.

Ecosystem Organization

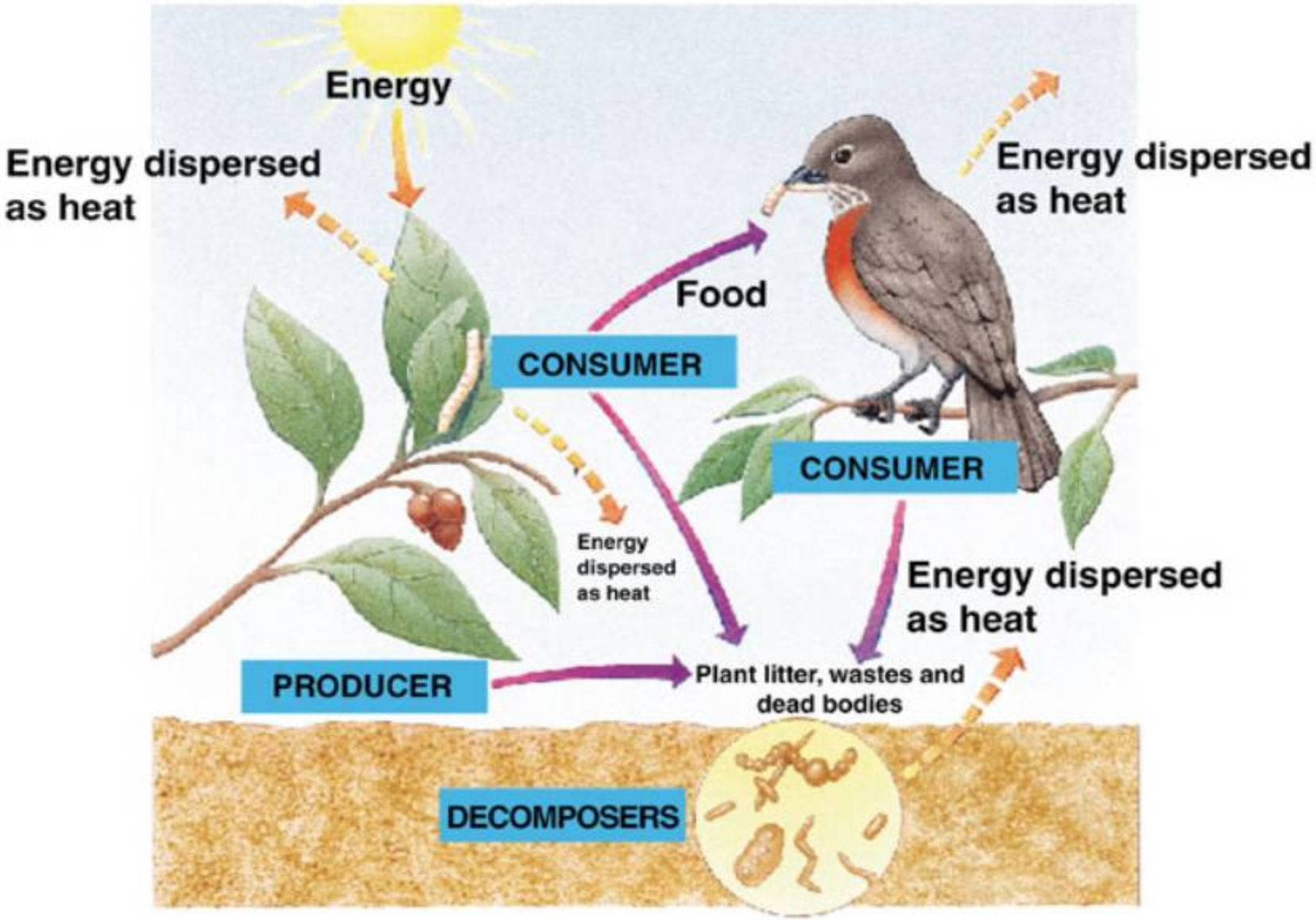
Each system can help clarify different issues.

1. **Trophic Pyramids**

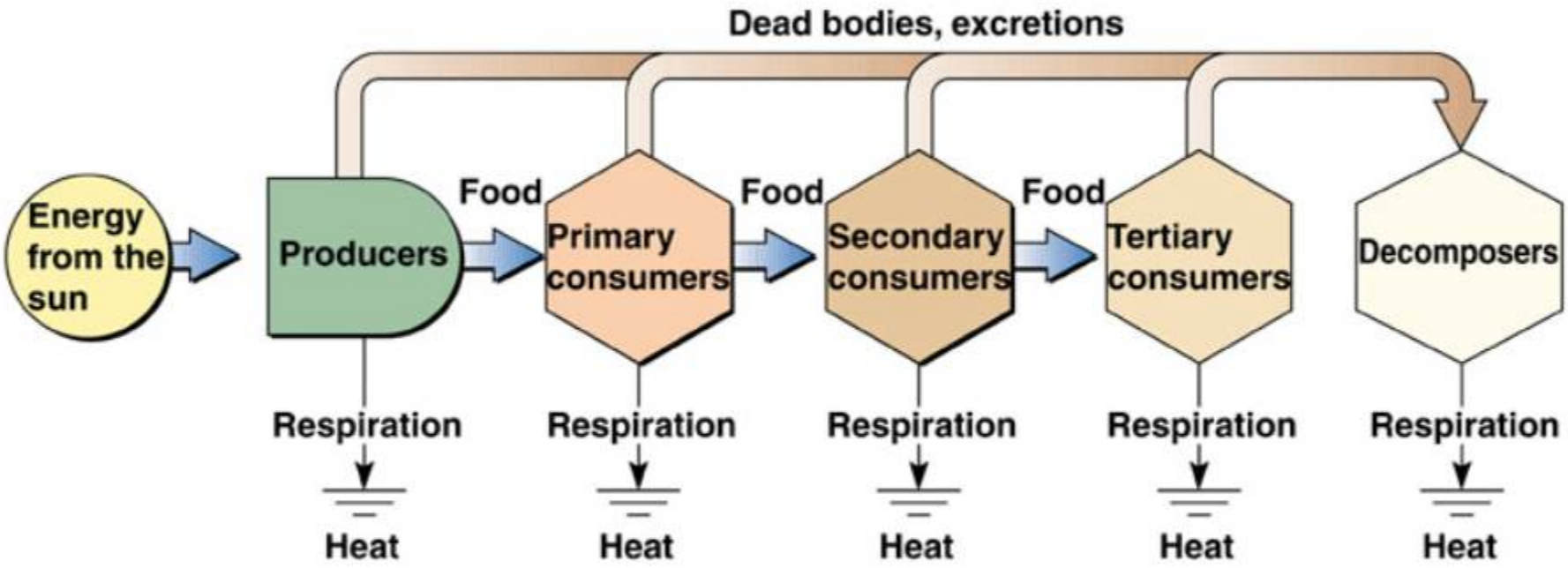
2. **Food Webs**

3. **Nutrient Cycles**

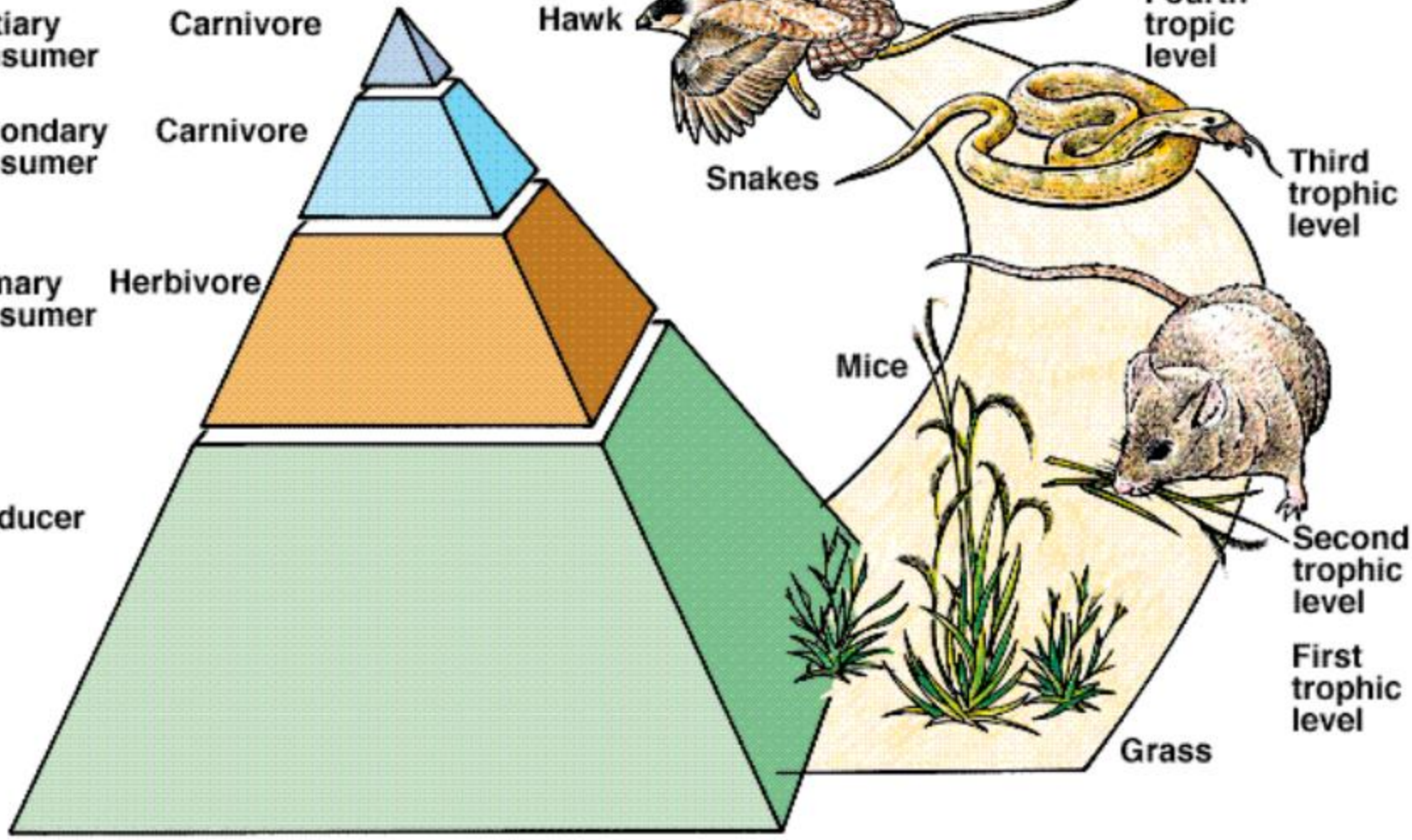
Raven/Berg, Environment, 3/e
Figure 4.6

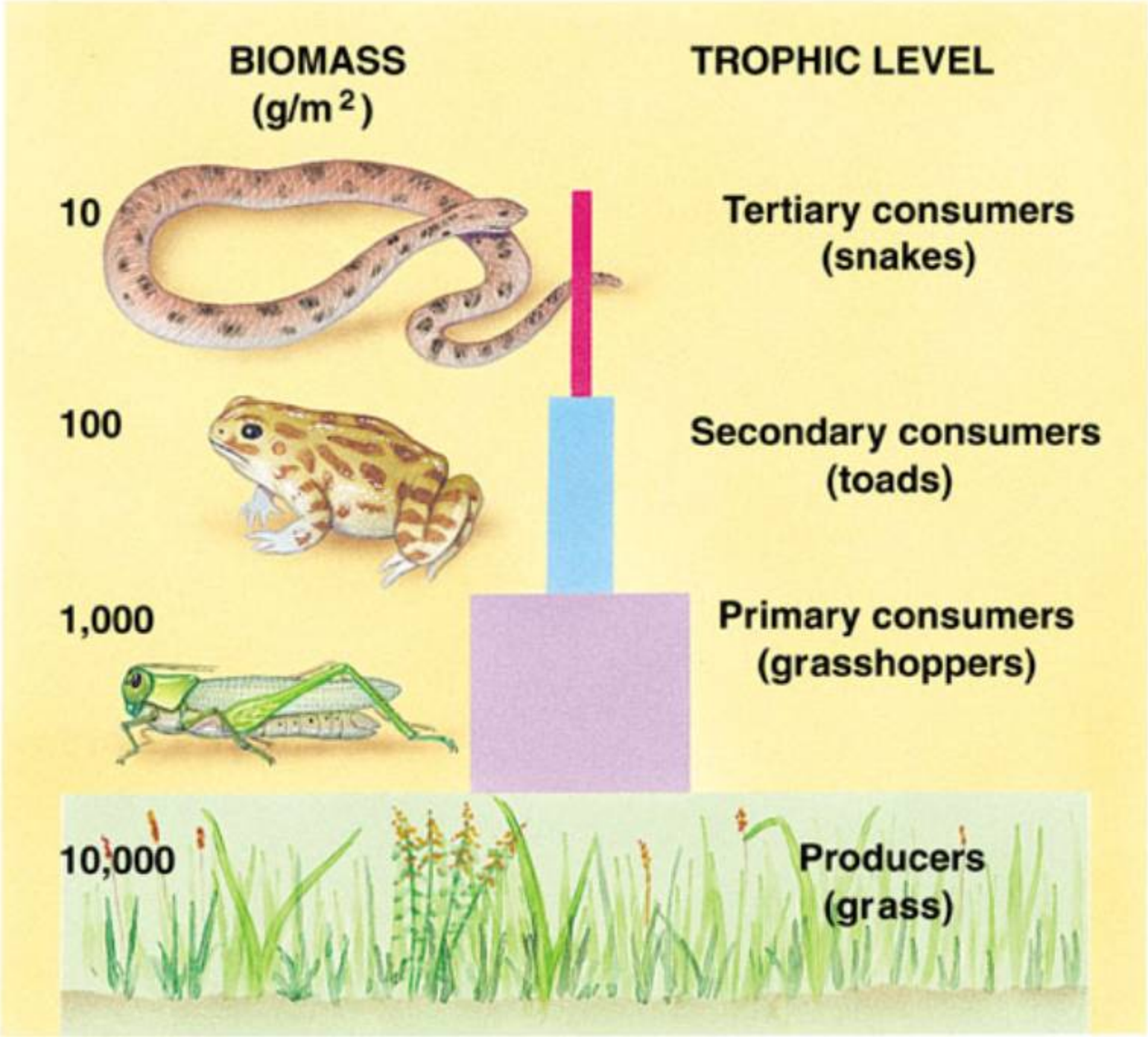


Raven/Berg, Environment, 3/e
Figure 4.7

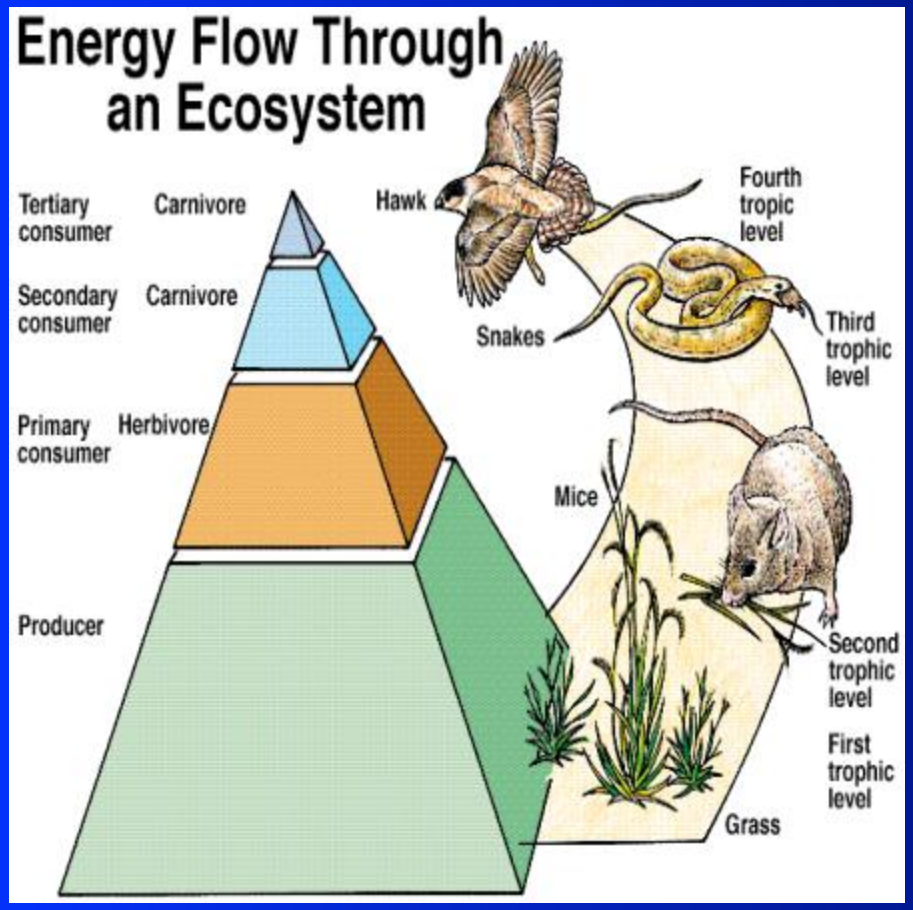


Energy Flow Through an Ecosystem




BIOMASS
(g/m 2)
TROPHIC LEVEL
10
Tertiary consumers
(snakes)
100
Secondary consumers
(toads)
1,000
Primary consumers
(grasshoppers)
10,000
Producers
(grass)

Pyramids of Energy Suggests:



1. The number of trophic levels are limited. At each trophic level, there is a dramatic reduction in energy.

2. Eating at lower trophic levels means more resources are available.

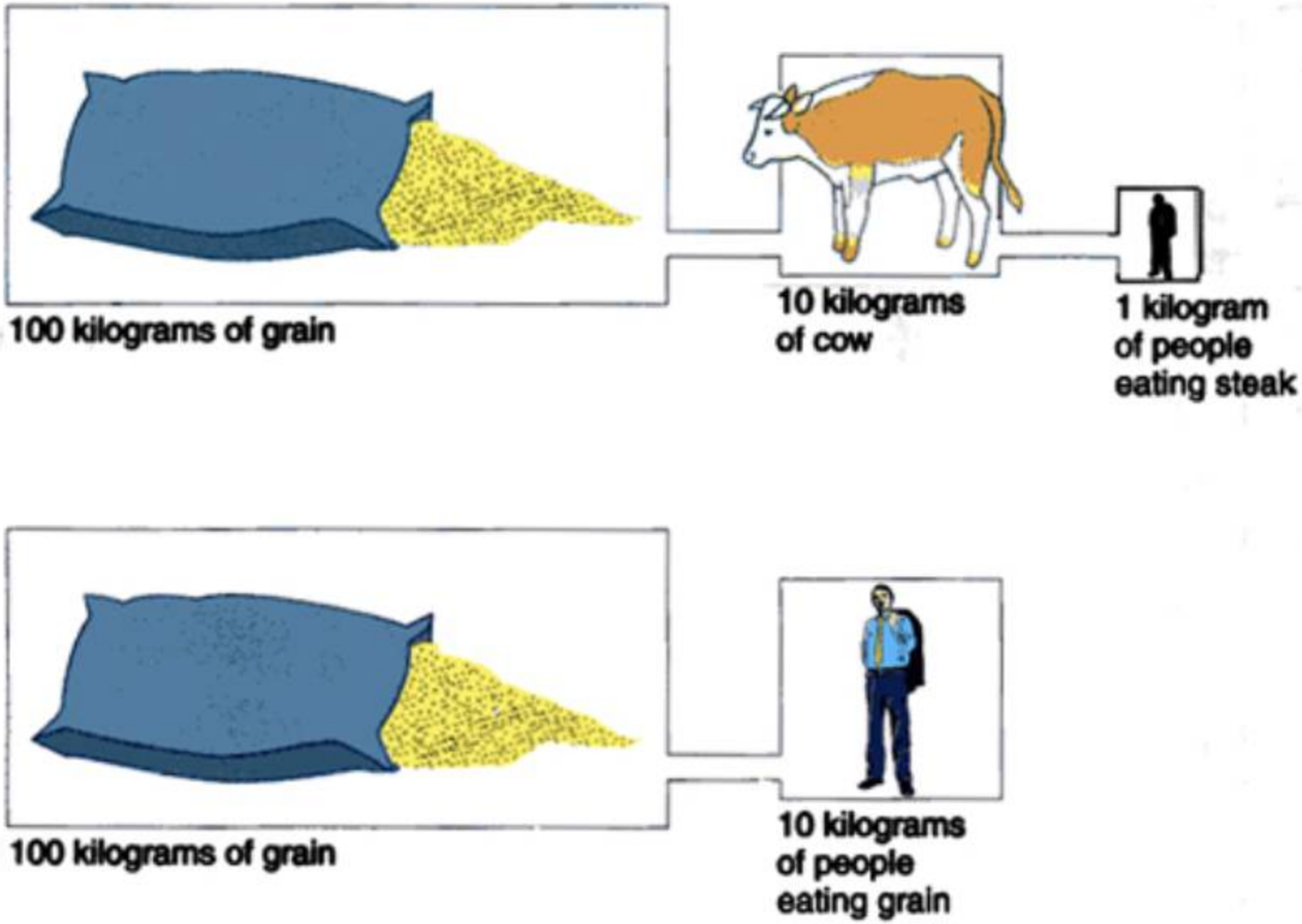


Figure 14.23

Human Biomass Pyramids

Pyramids of Energy Suggests:

1. The number of trophic levels are limited. At each trophic level, there is a dramatic reduction in energy.

2. Eating at lower trophic levels means more resources available.

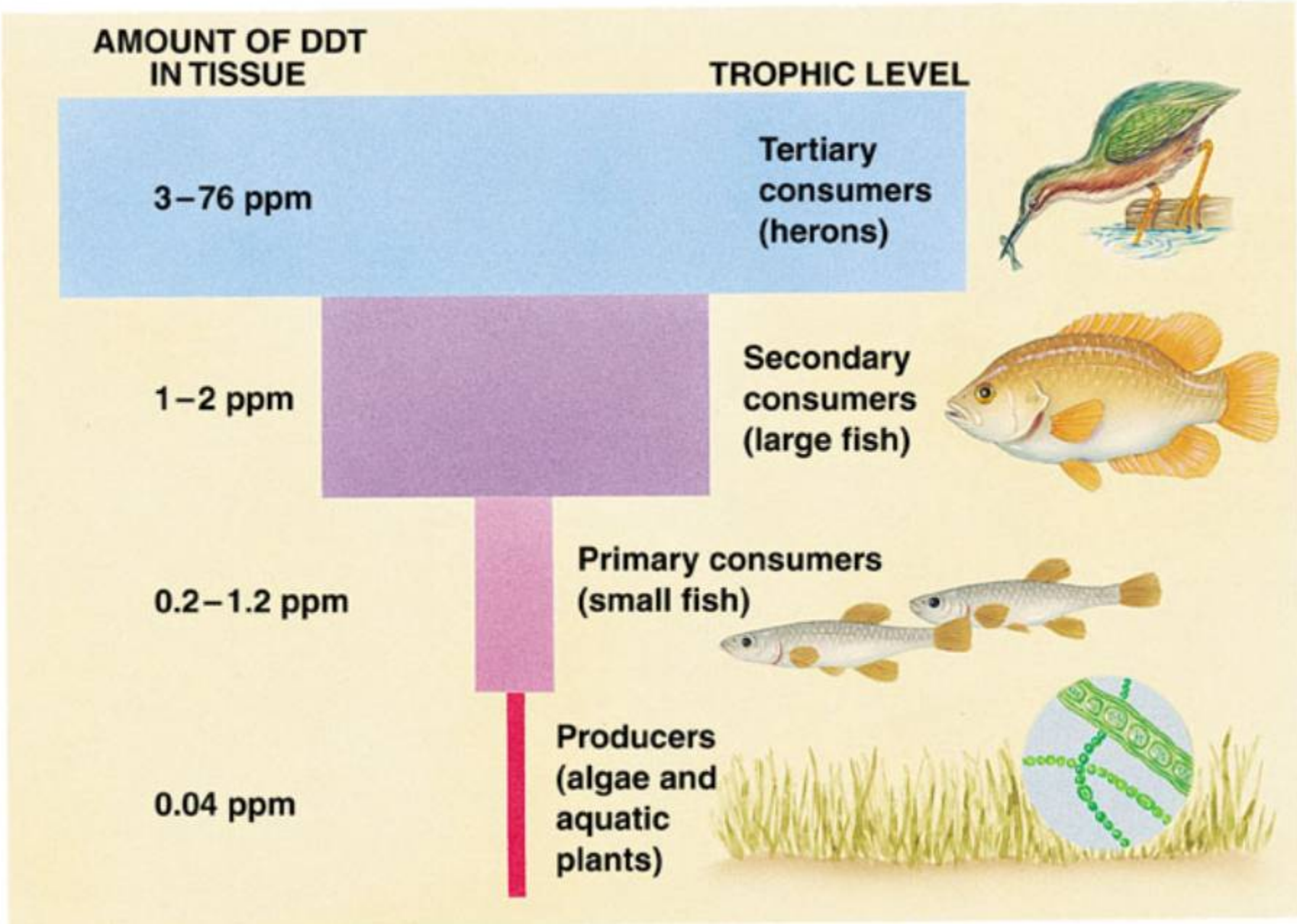
3. Movement up the pyramid explains the problems of **Biological Magnification** (DDT, PCBs, etc.)

Biological Magnification

Concentration of a compound can increase at higher trophic levels because **each individual** in a higher trophic level must eat **many** individuals of a lower trophic level to survive.

Although the energy acquired by eating those organisms from a lower trophic level is used, the toxic compounds may remain (Especially true for compounds that are stored in fats and are not easily broken down.).

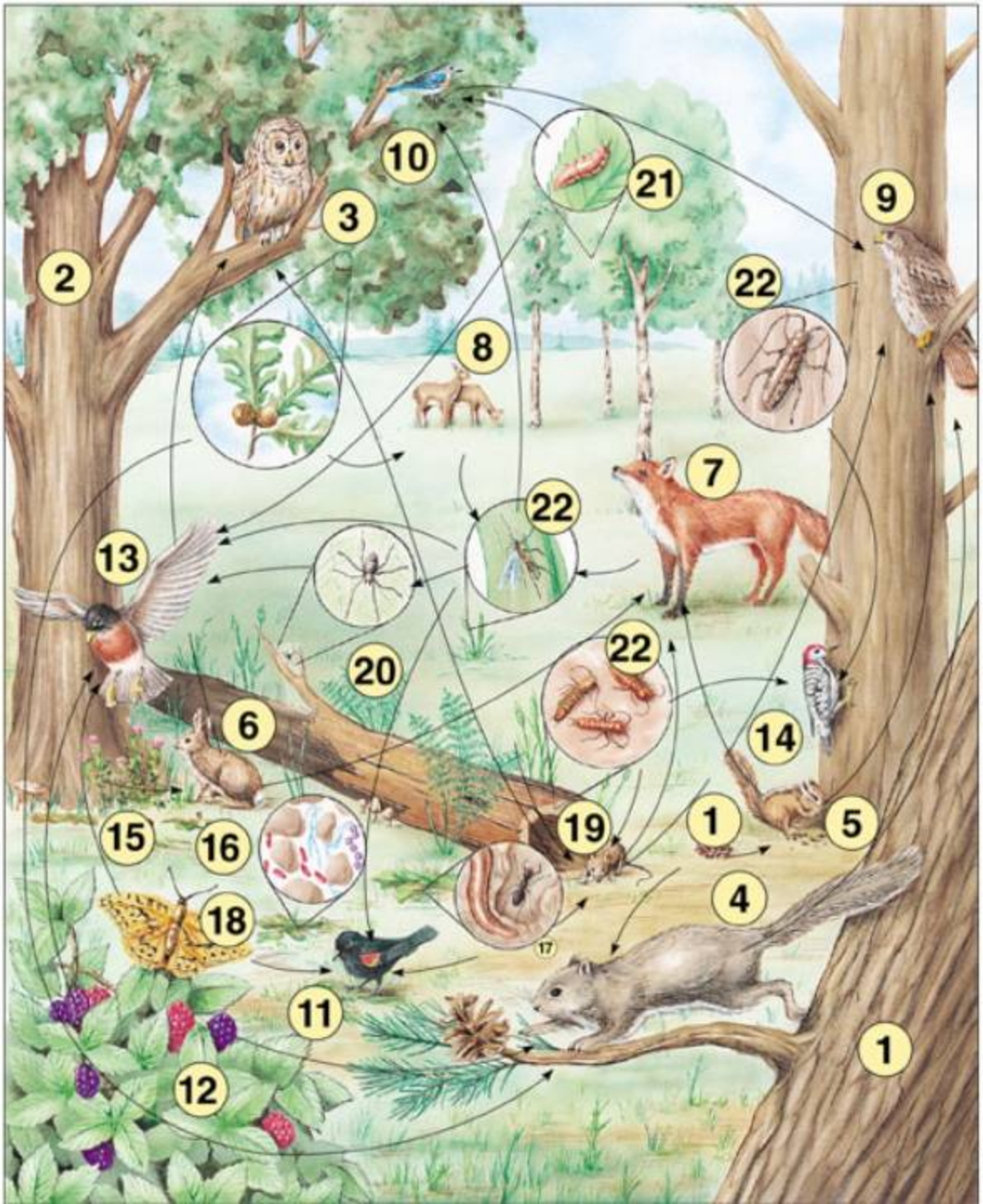
Raven/Berg, Environment, 3/e
Figure 22.9



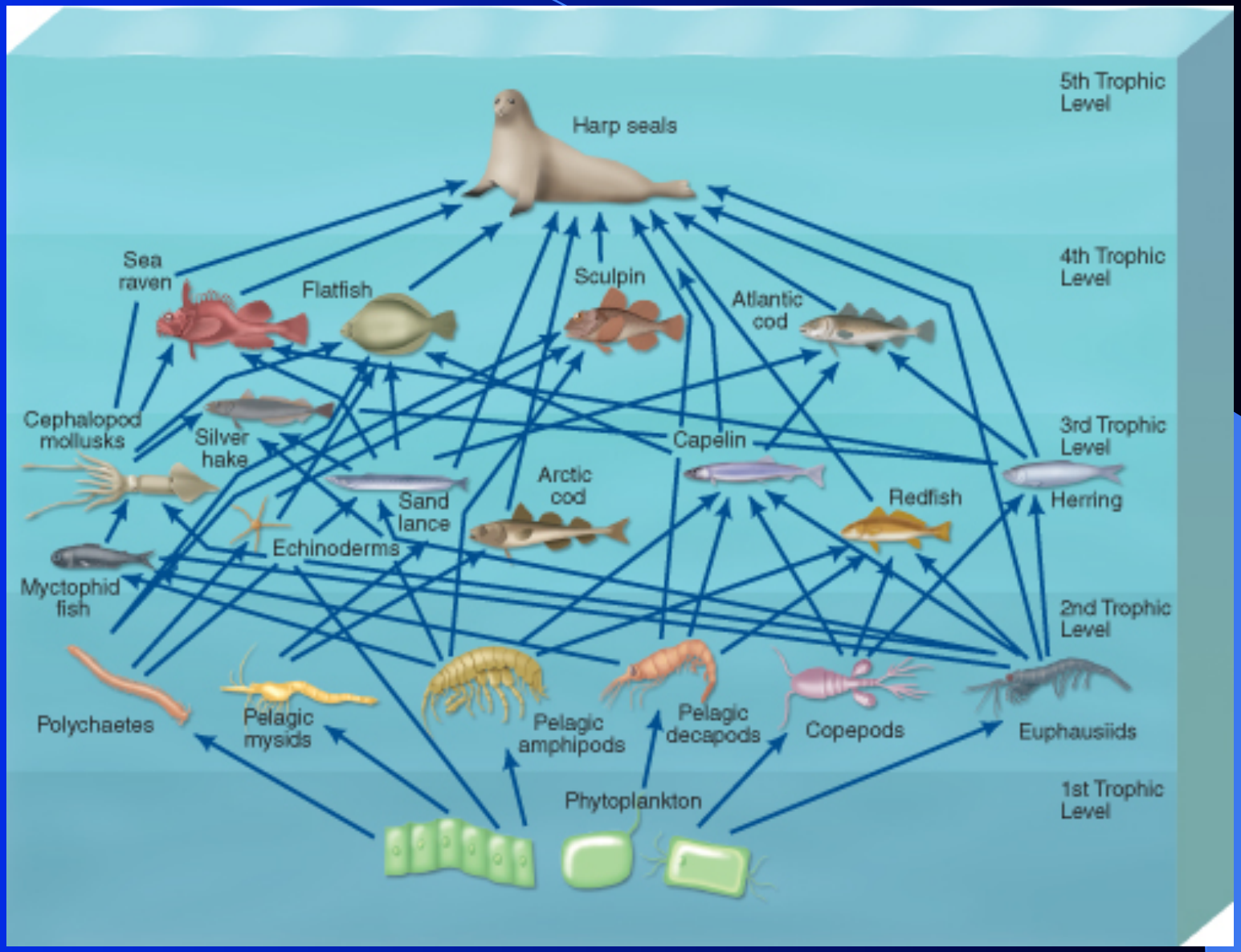
Food webs

Are interlocking food chains based on which organisms eat which.

Arrows show the direction of food/energy flow



Ocean Food Web



Ecological Pyramids

- Pyramid of energy
- Pyramid of numbers
- Pyramid of biomass

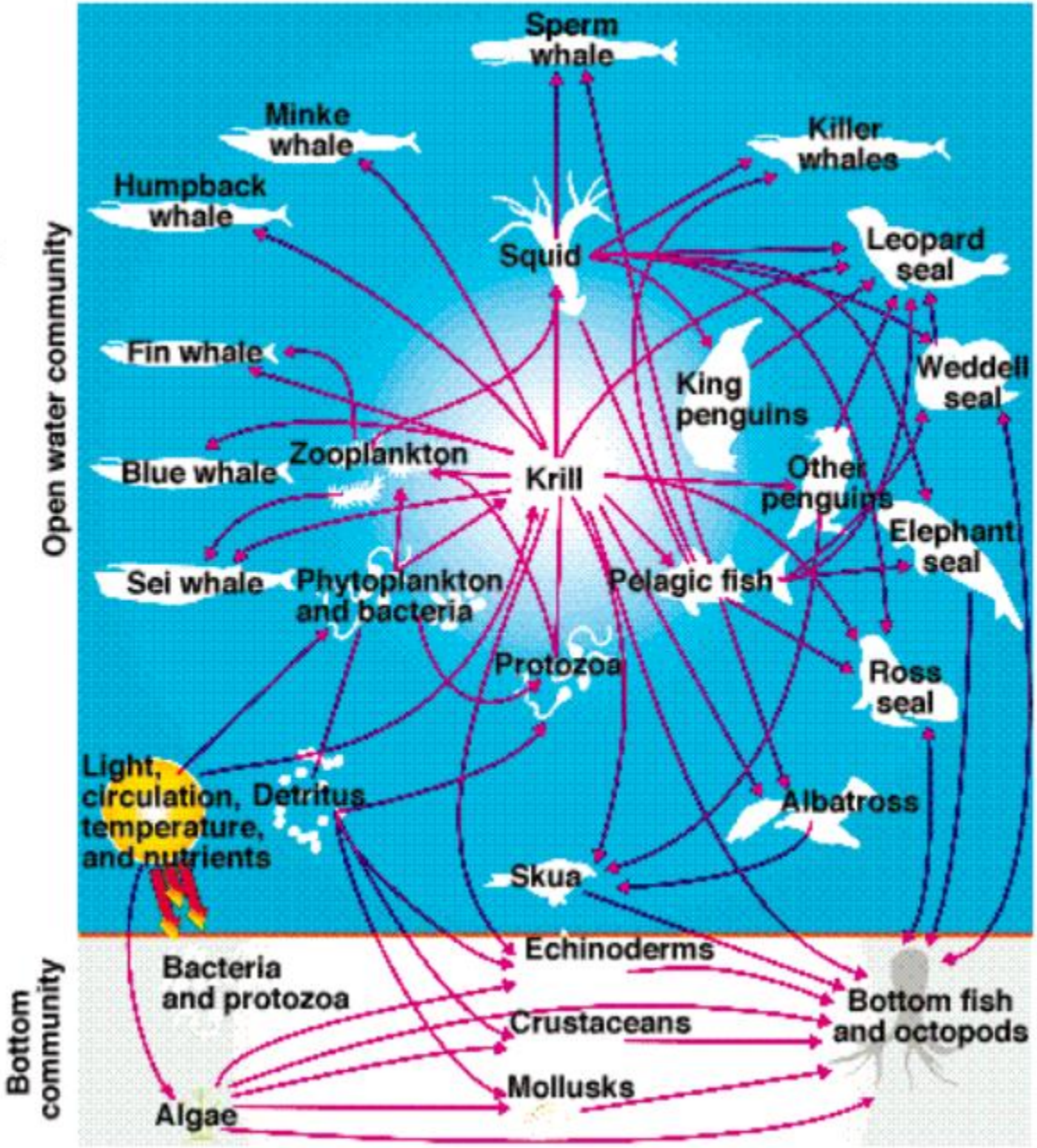
Gross Primary Productivity **= total amount of energy captured by photosynthesis for an ecosystem.**

Keystone Species

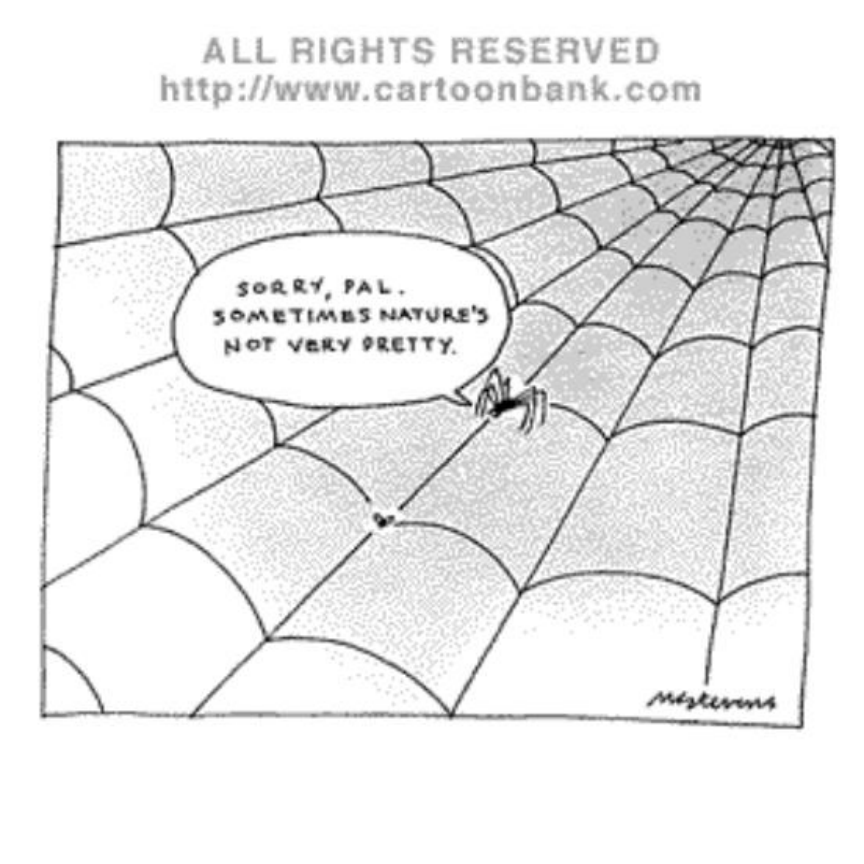
Food webs suggest that keystone species may be important. Changes in one species may dramatically change the entire ecosystem through links in the web.

Keystone Species = **Species whose presence is essential to community function and stability (e.g., Krill in Antarctica).**

Antarctic marine food web.



Evolution, Natural Selection, and Communities



Topics And Objectives

Evolution by Natural Selection

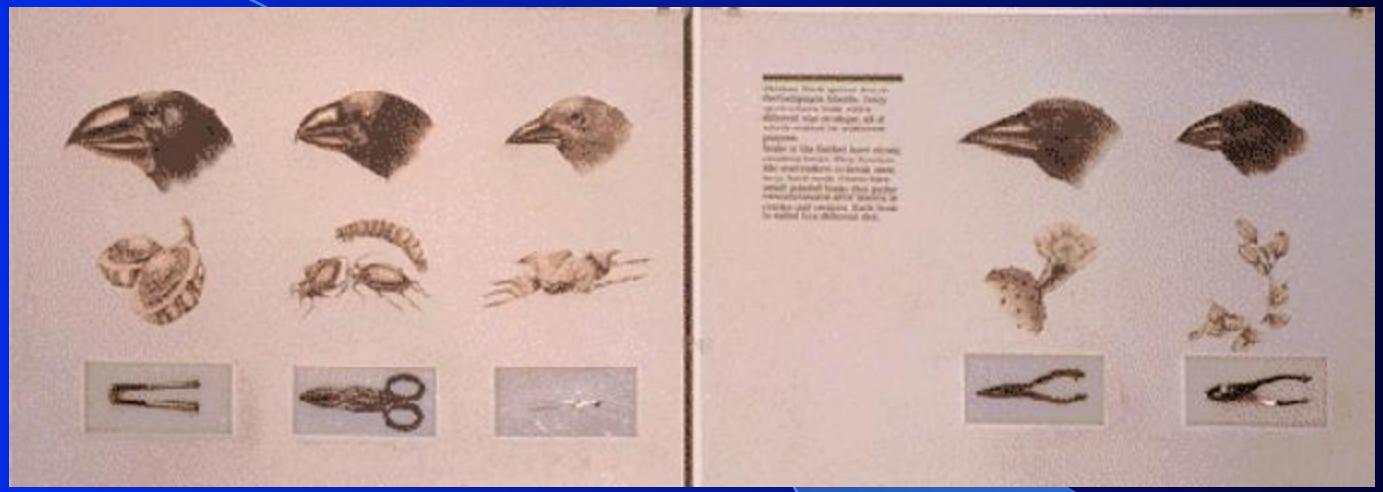
Community

Species Interactions

Species Diversity

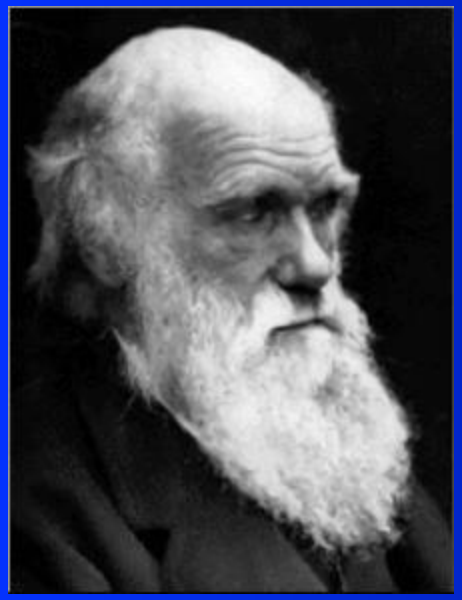
Succession

Evolution and Natural Selection



The Underlying Mechanisms of Species Diversity

Charles Darwin



"There is grandeur in this view of life, with its several powers, having been originally breathed by the Creator into a few forms or into one; and that, whilst this planet has gone on cycling on according to the fixed law of gravity, from so simple a beginning endless forms most beautiful and most wonderful have been, and are being evolved."

--The Origin of Species

Charles Darwin

Grantham

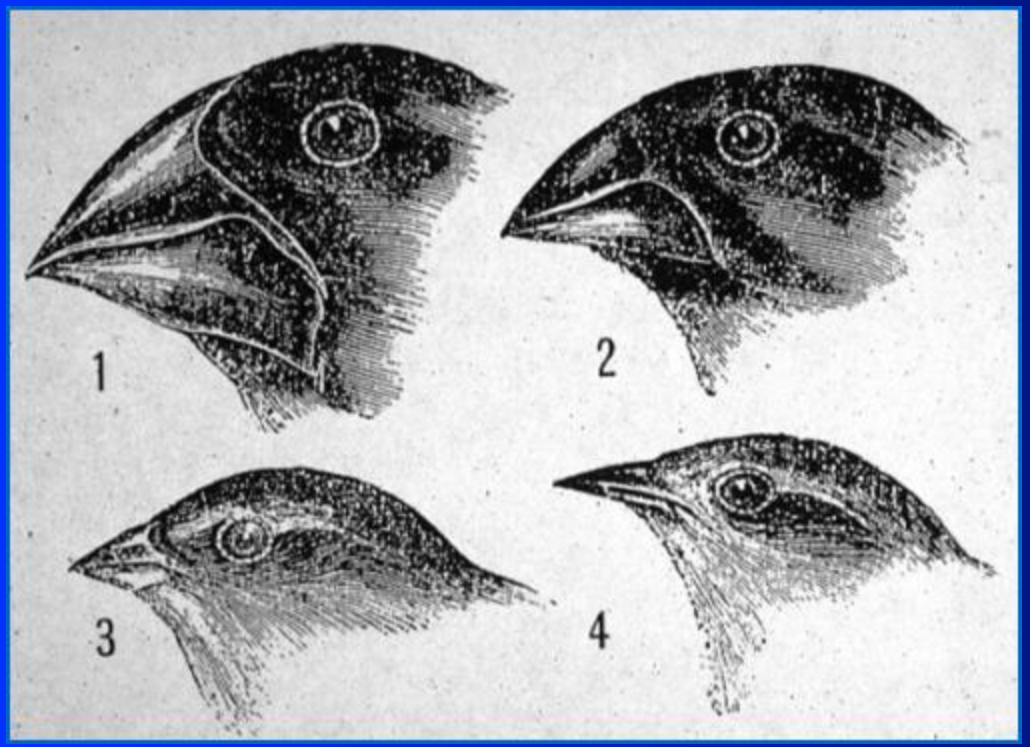
Darwin was born into the family of a prominent physician on February 12, 1809, in Shrewsbury, England. His mother was the daughter of Josiah Wedgewood, founder of the famous pottery firm. In 1825 Charles entered the University of Edinburgh to become a physician. Two years later he entered Cambridge University to study for the clergy.

Charles Darwin

In 1831 Darwin joined the *HMS Beagle* as the naturalist for a circumnavigation of the world; the voyage lasted five years. It was his observations from that trip that lead to his proposal of natural selection to explain the diversity of organisms.

It was not until 1859 that Darwin finally published his *Origin of Species*.

Darwin's Finches



"**The most curious fact is the perfect gradation in the size of the beaks** in the different species of Geospiza, from one as large as that of a hawfinch to that of a chaffinch, and (if Mr. Gould is right in including in his sub-group, Certhidea, in the main group), even to that of a warbler. The largest beak in the genus Geospiza is show in **Fig. 1**, and the smallest in **Fig. 3**; but instead of their being only one intermediate species, with a beak of the size shown in **Fig. 2**, there are no less than six species with insensibly graduated beaks. The beak of the sub-group Certhidea, is shown in **Fig. 4**. The beak of Cactornis is somewhat like that of a starling; and that of the fourth sub-hroup, Camarhynchus, is slightly parrot-shaped. **Seing this gradation and diversity of structure in one small, intimately related group of birds, one might really fancy that from an original paicity of birds in this archipelago, one species had been taken and modified for different ends** [**stress** added]." Charles R. Darwin, 1845, *The Voyage of the Beagle* [Edited by Leonard Engel, 1962, NY: Doubleday], pages 380-381.

Darwins's Four Premises

1. Each species produces more offspring than will survive to maturity.

2. Individuals in a population exhibit variation.

3. There are limits on population growth imposed by the environment.

4. There is differential reproductive success among individuals within a population.

What is Evolution?

- **Descent with modification.**
- **Change in the genetic structure of a population.**

Mechanisms That Change the Genetic Structure of a Population And Cause Evolutionary Change?

1. **Genetic mutations**
2. **Genetic drift** (Isolation of populations and different accumulations of mutations)
3. **Founder effect** (Small initial reproductive populations with limited genetic diversity)
4. **Natural selection** (Differential reproductive potential)

What Is Natural Selection?

- Differential survival and reproduction among individuals of a population.
- Response to selection pressures.
- Genetic variations refer to the number of individuals within a population each having a unique combination of traits.

Relationship of Evolution and Selection Pressures to Environmental Science

1. Biodiversity arises through evolution.
    1. Human disturbance changes selective pressures.
    2. Conservation of individual species.

Process of Evolution through Natural Selection

1. Overproduction
2. Resources limit population growth
3. Heritable variation in traits.
4. Differential survival and/or reproduction

Potential Selective Pressures

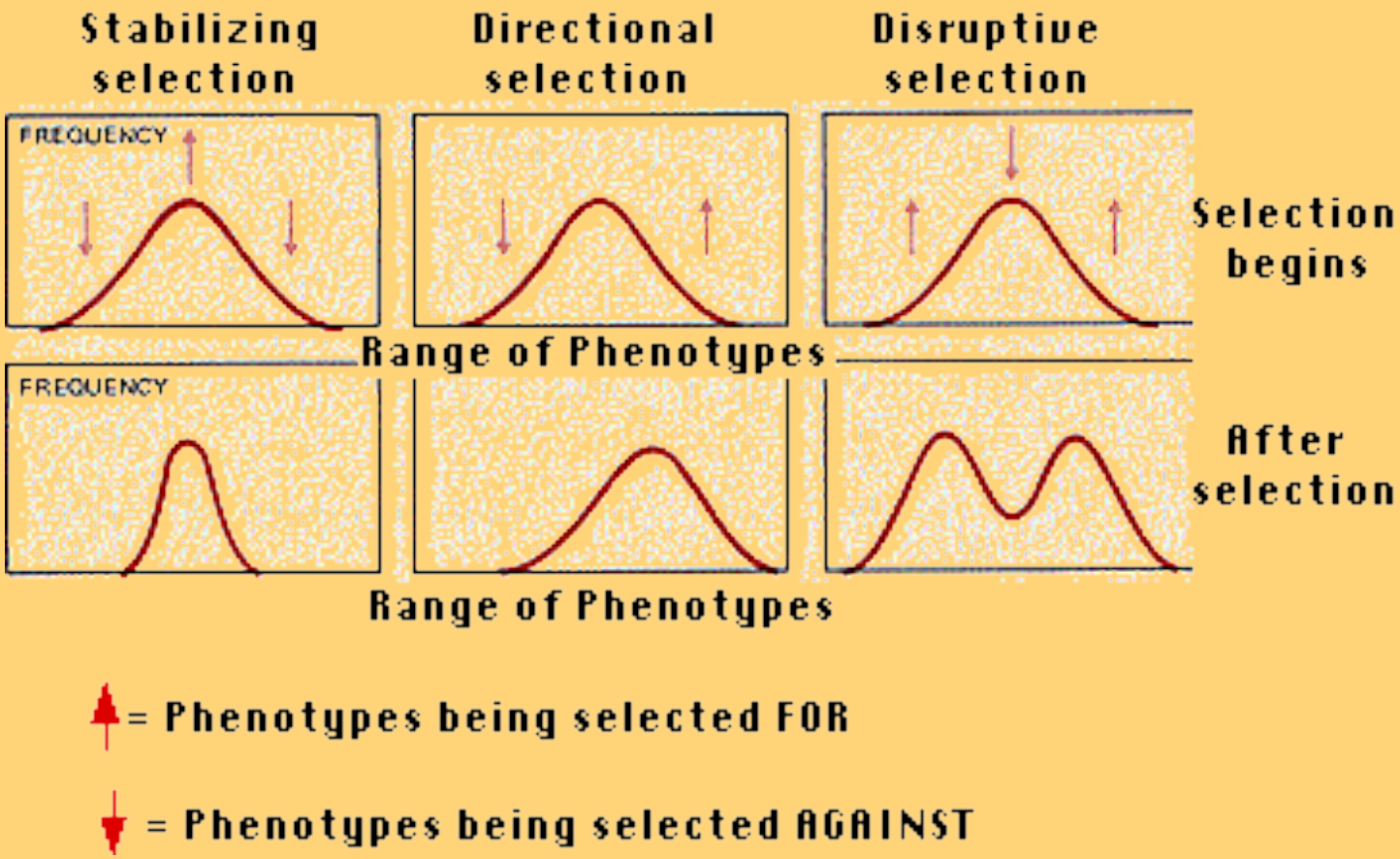
Abiotic

- Temperature
- Precipitation
- pH (acidity)

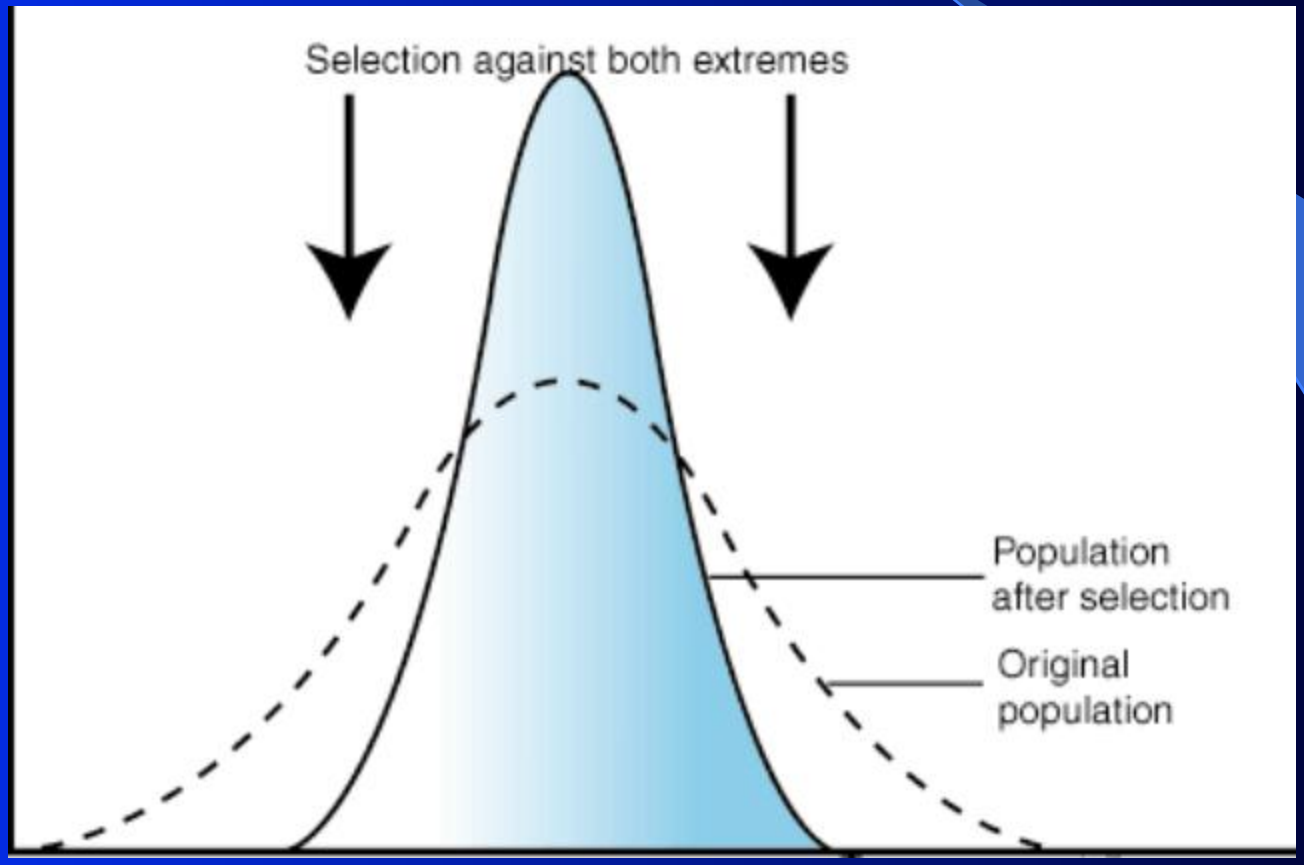
Biotic

- Predation
- Disease
- Competition

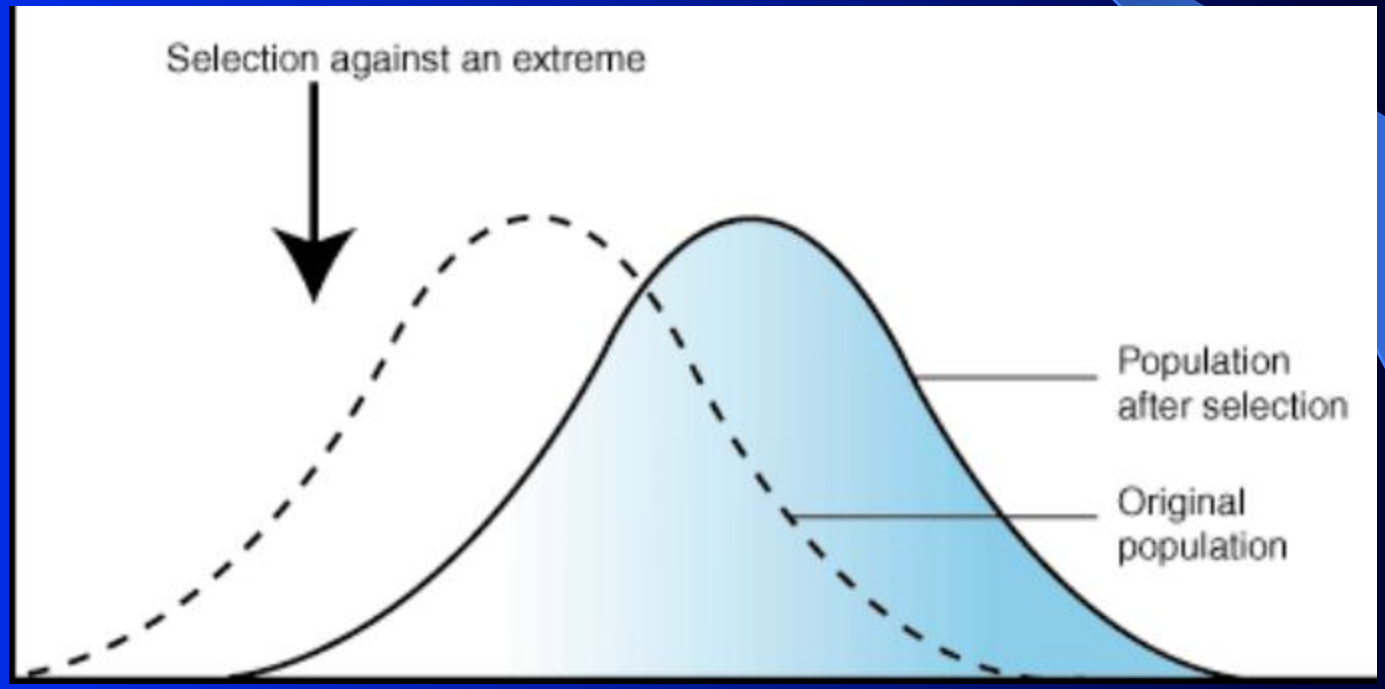
Types of Selection



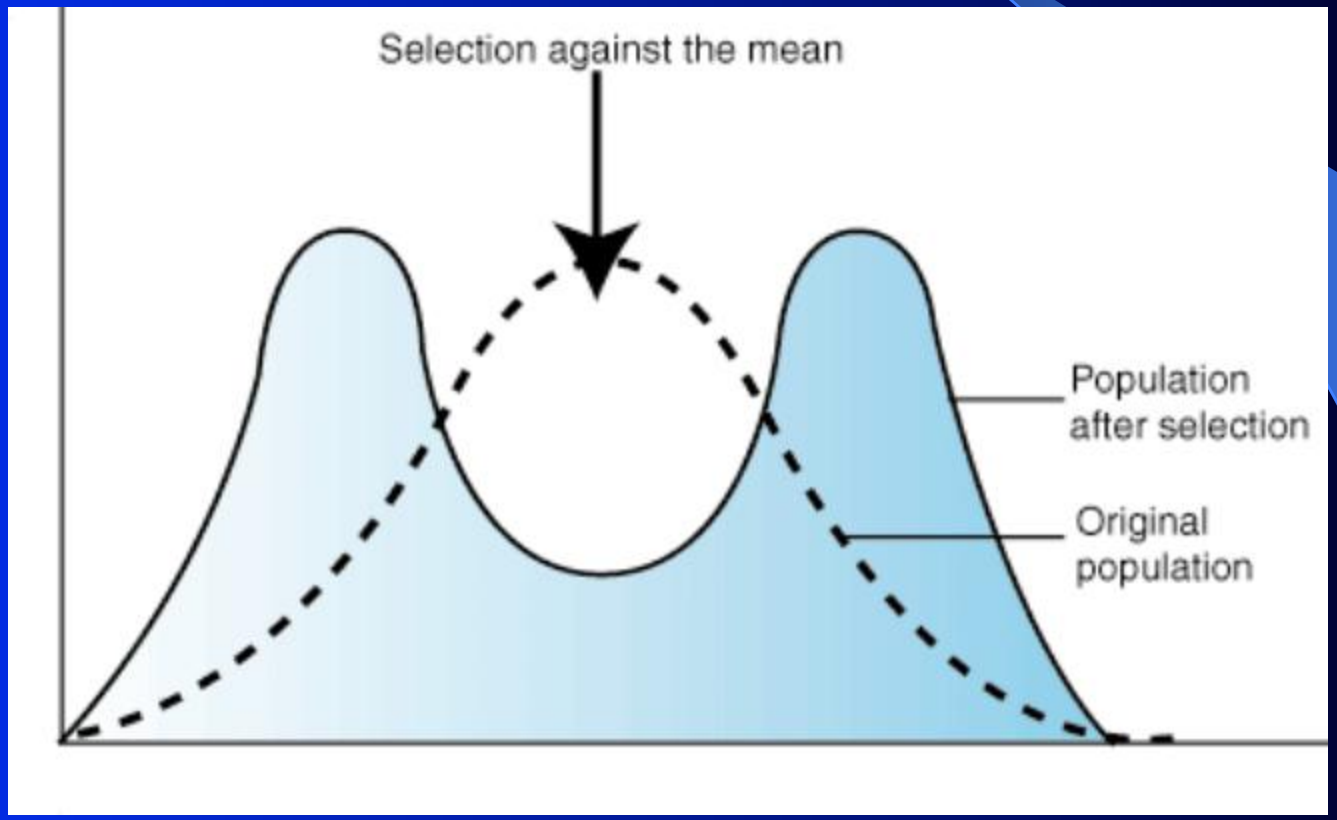
Stabilizing Selection



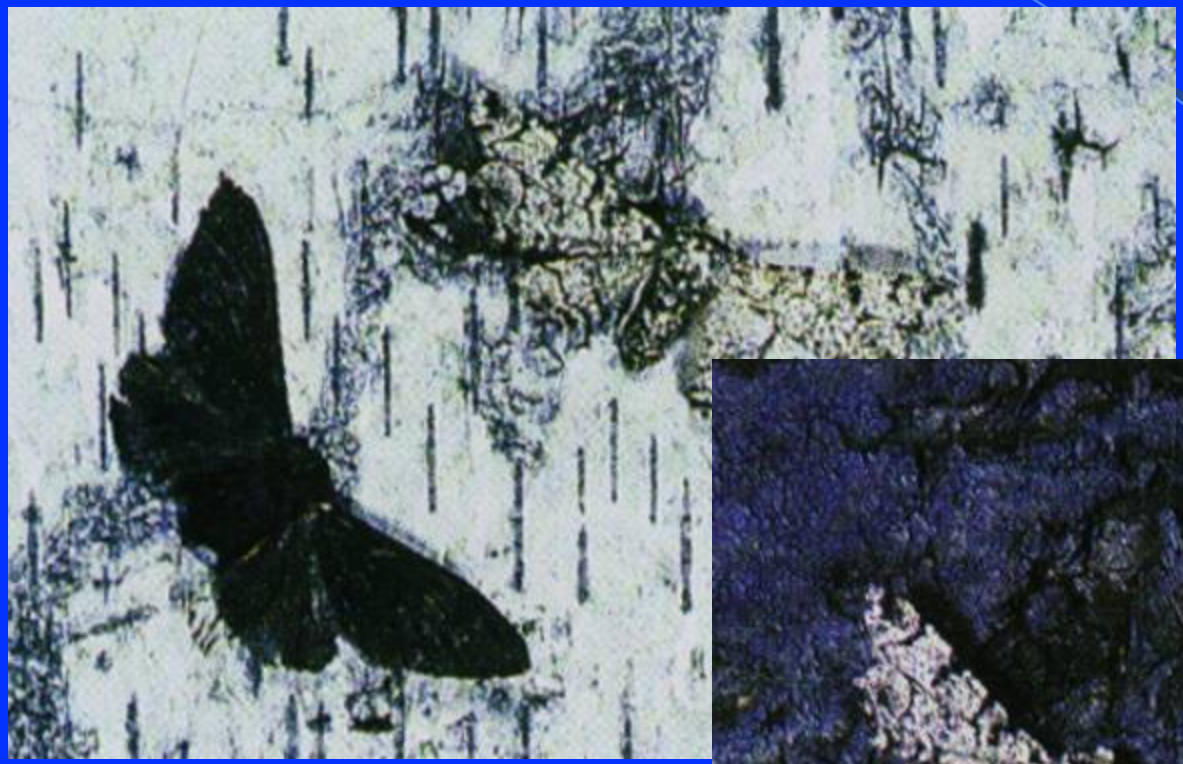
Directional Selection



Disruptive Selection

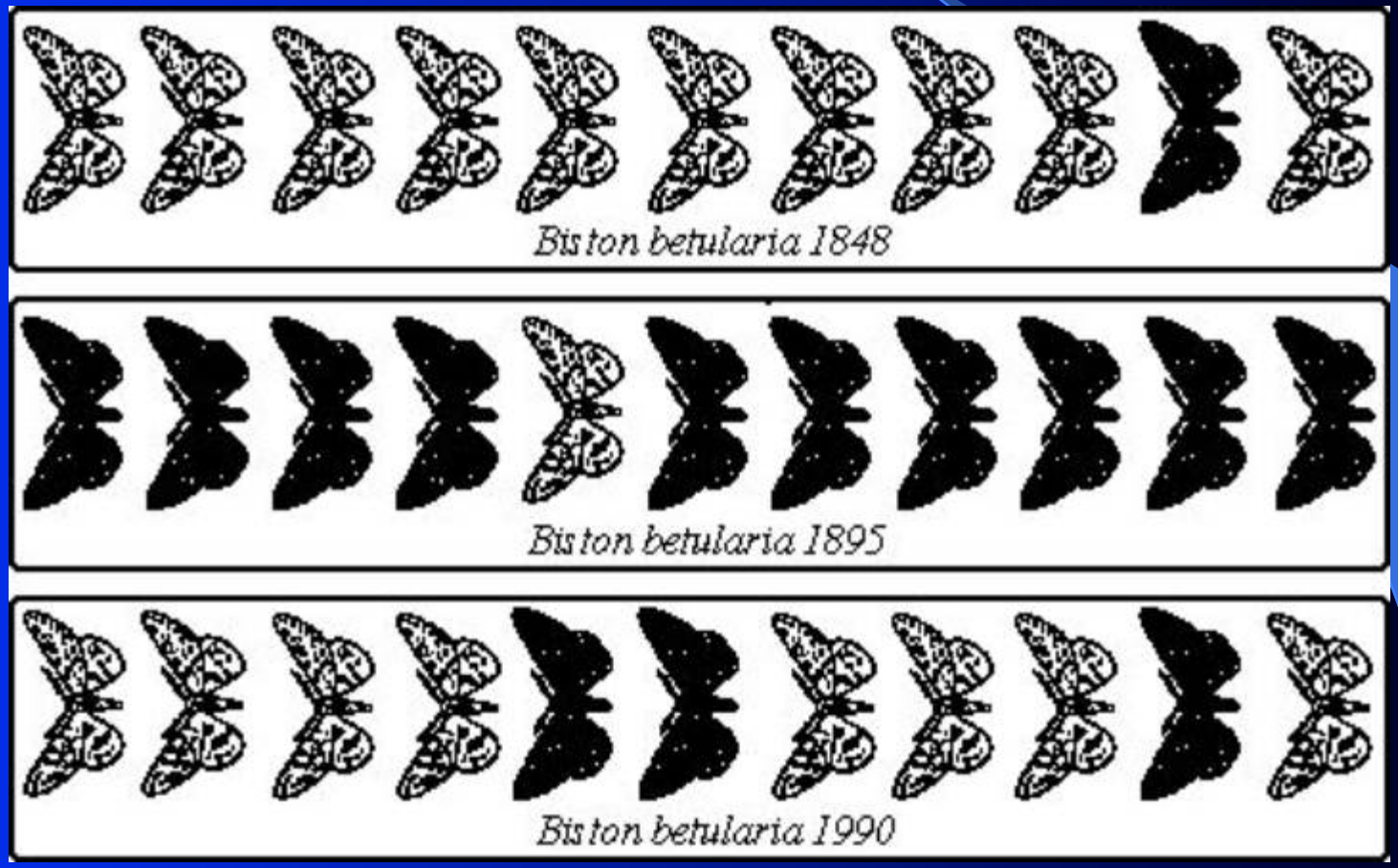


Example of Natural Selection: Peppered Moth



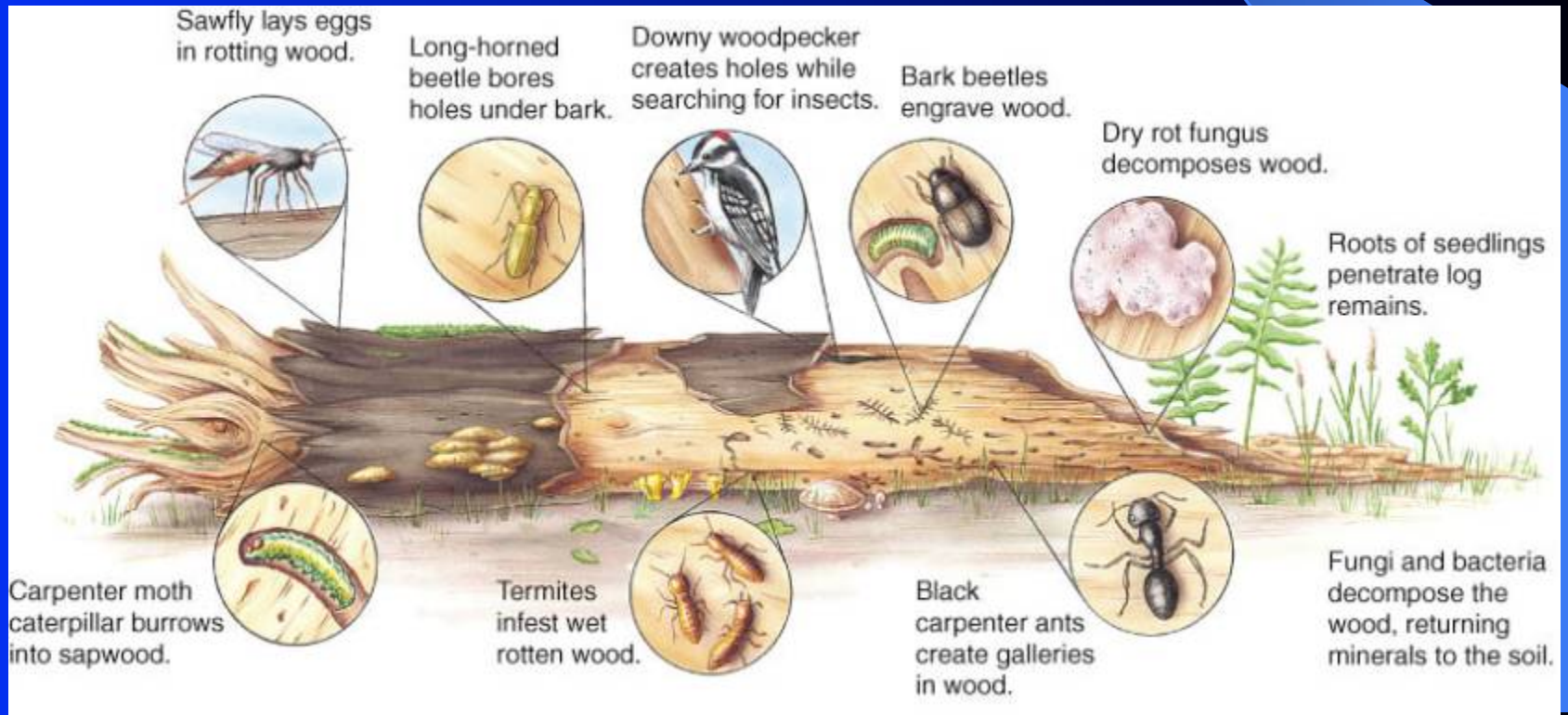
Cunningham & Saigo, Environmental Science. 2001 by McGraw Hill

Peppered Moths



Community

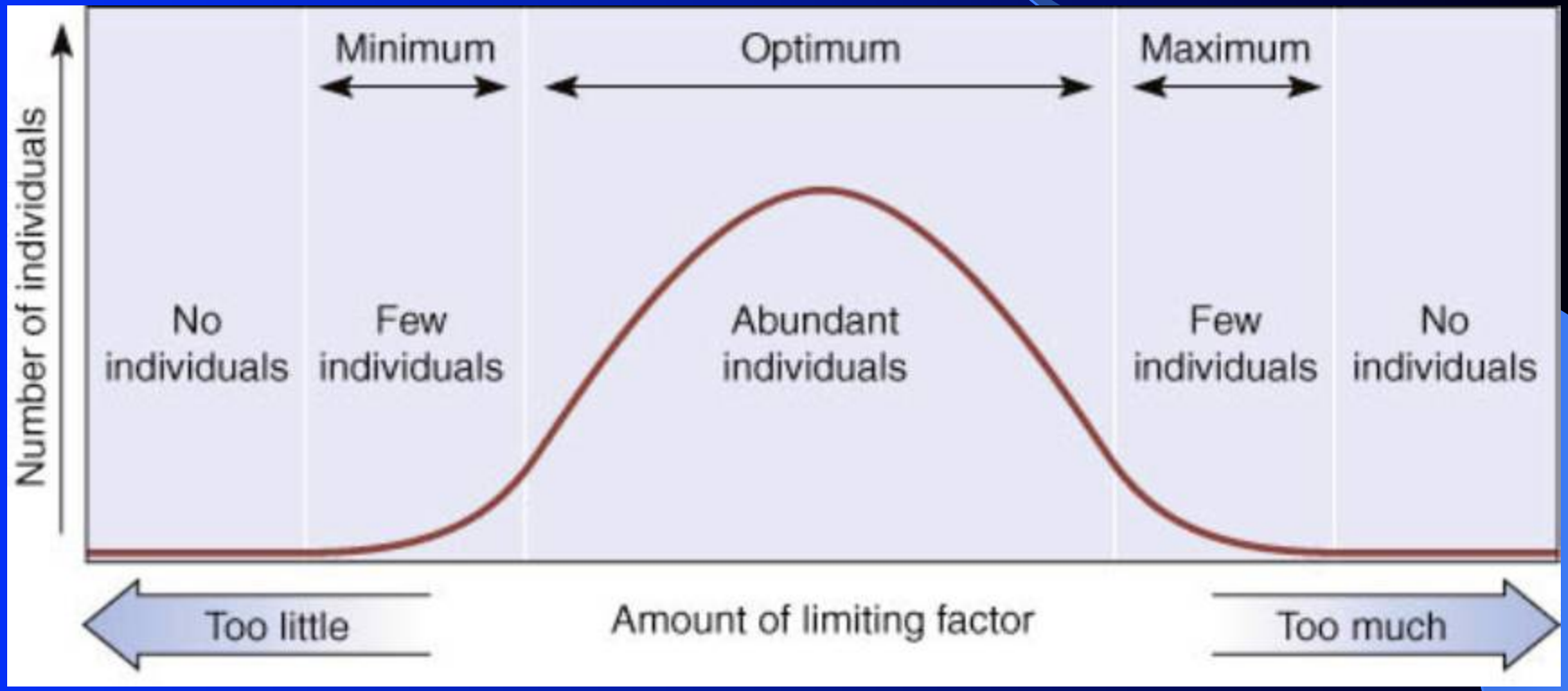
Association of different populations of organisms that live and interact together in the same place at the same time.



The Underlying Bases of Community Structure is Species Interactions

And NUH is the letter I use to spell Nutches
Who live in small caves, know as Nitches, for Nutches.
These Nutches have troubles, the biggest of which is
The fact that there are many more Nutches than Nitches.
Each Nutch in a Nitch knows that some other Nutch
Would like to move into his Nitch very much.
So each Nutch in a Nitch has to watch that small Nitch
or Nutches who haven't got Nitches will snatch.
Dr. Suess (Geisel, 1955)

Limiting Factors



Summary of Community Structure

The numbers and types of organisms that exist in an ecological niche are dependent upon both the physiological resources available and the relationships between different species.

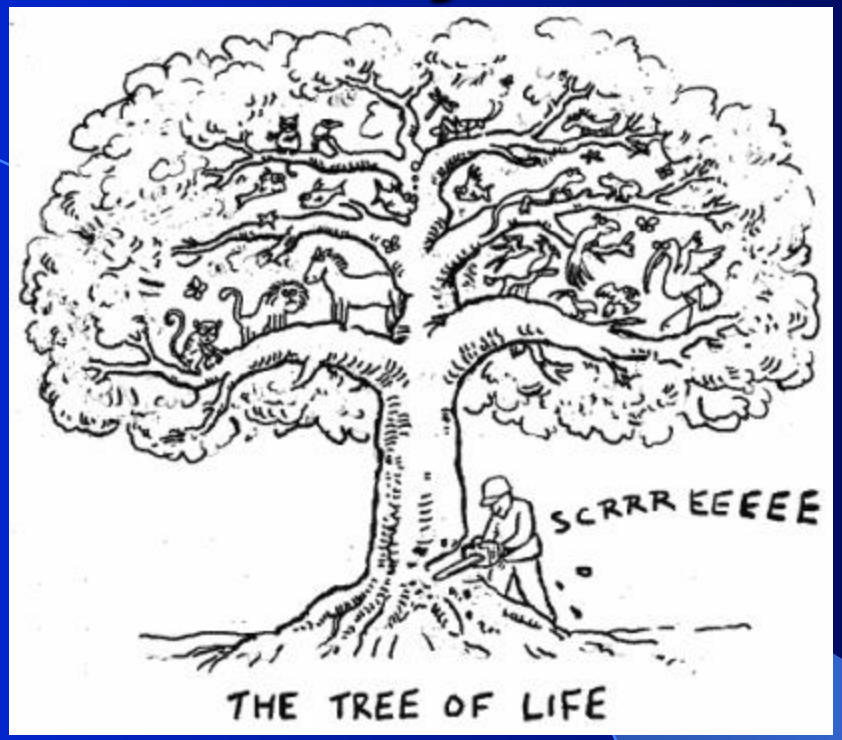
Resources are limited in an ecosystem, and species survive because of strategies that ensure adequate access to the resources and minimize competition for resources with other species.

Summary of Community Structure

As resources change and species interactions change over time, those members of the species best adapted to the new conditions are the individuals that live to reproduce and pass on their genetic information.

Thus, because of our ever changing world, over time there are changes in the gene pool of a population (i.e., evolution). Evolution ***is not*** a directed choice, it is the consequence of natural selection. In many cases natural selection leads to the loss of an entire species (e.g., the dodo).

Species Diversity and Succession

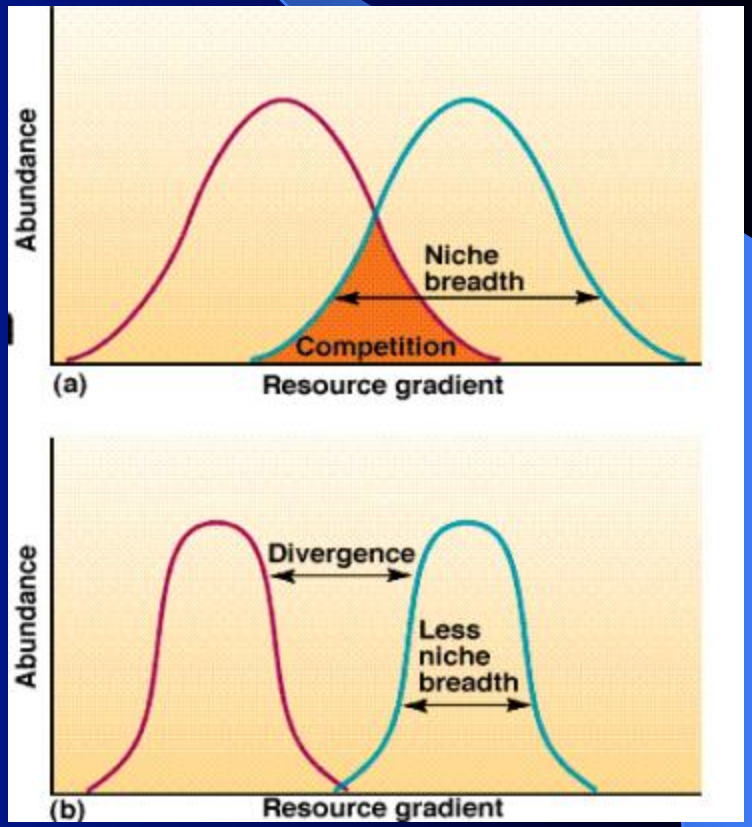


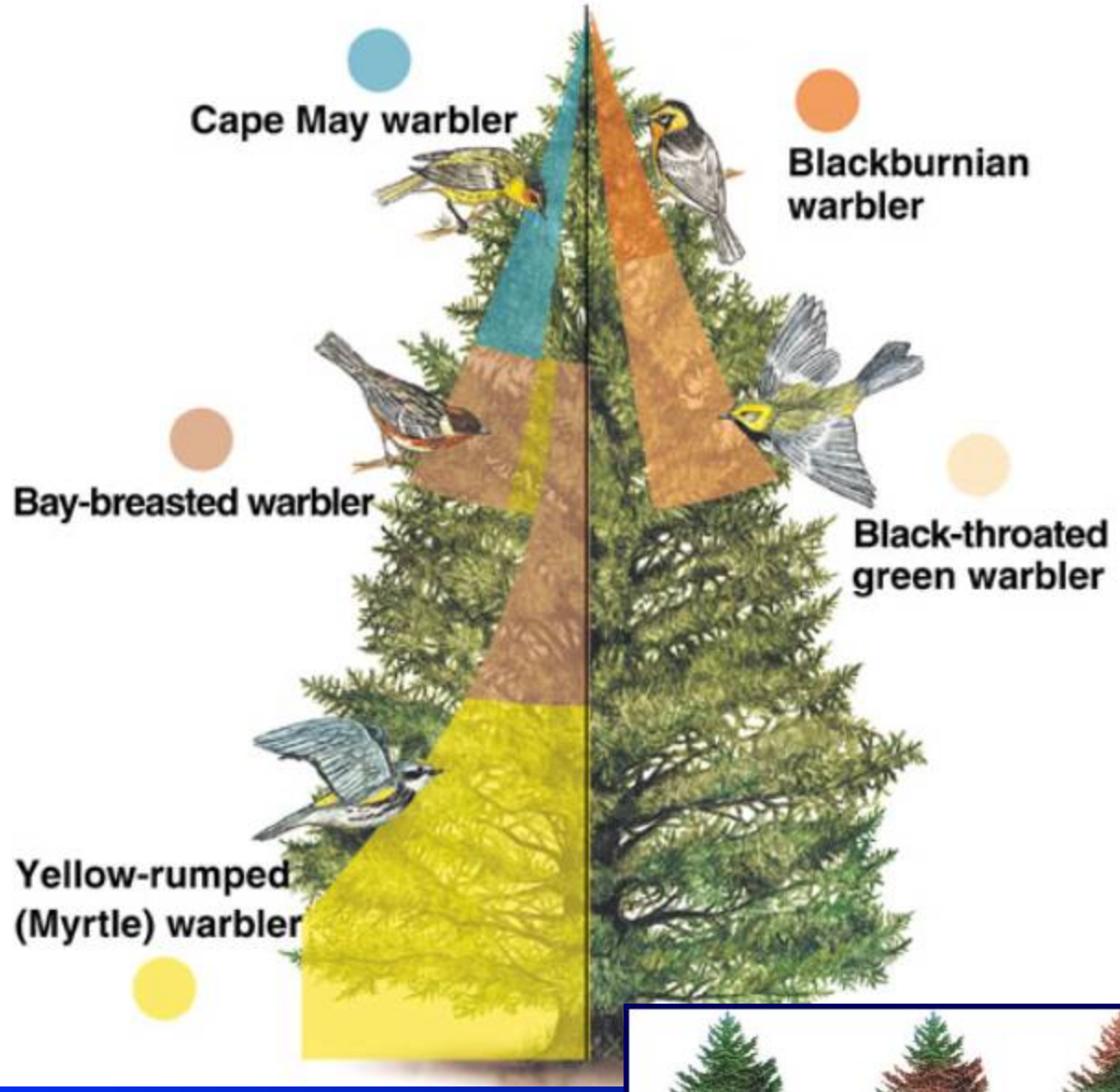
The Dynamics of Community Structure

Resource Partitioning

Resource partitioning is reduced competition by evolving differences in resource use.

Resource partitioning occurs when natural selection acts to favor individuals of species that reduce competition by becoming more specialized.





Varblers as
xamples of
Resource
Partitioning -
ach species
pends at least
0% of foraging
ime in
esignated areas

Coevolution

Coevolution is reciprocal evolution. That is, an interdependent evolution of two or more species that occurs as a result of their interactions (suggests the importance of interactions for the structure of biotic communities - if one species is lost, the co-evolved species will be affected).

For predator/prey = "Arms race" (i/.e., The evolution of predator strategies to catch prey, and the responding prey strategies to escape predators.).

Evidence of Coevolution

Each of the following either improves the chance of catching prey or avoiding predator.

Predators:

- Rapid pursuit
- Ambush

Prey:

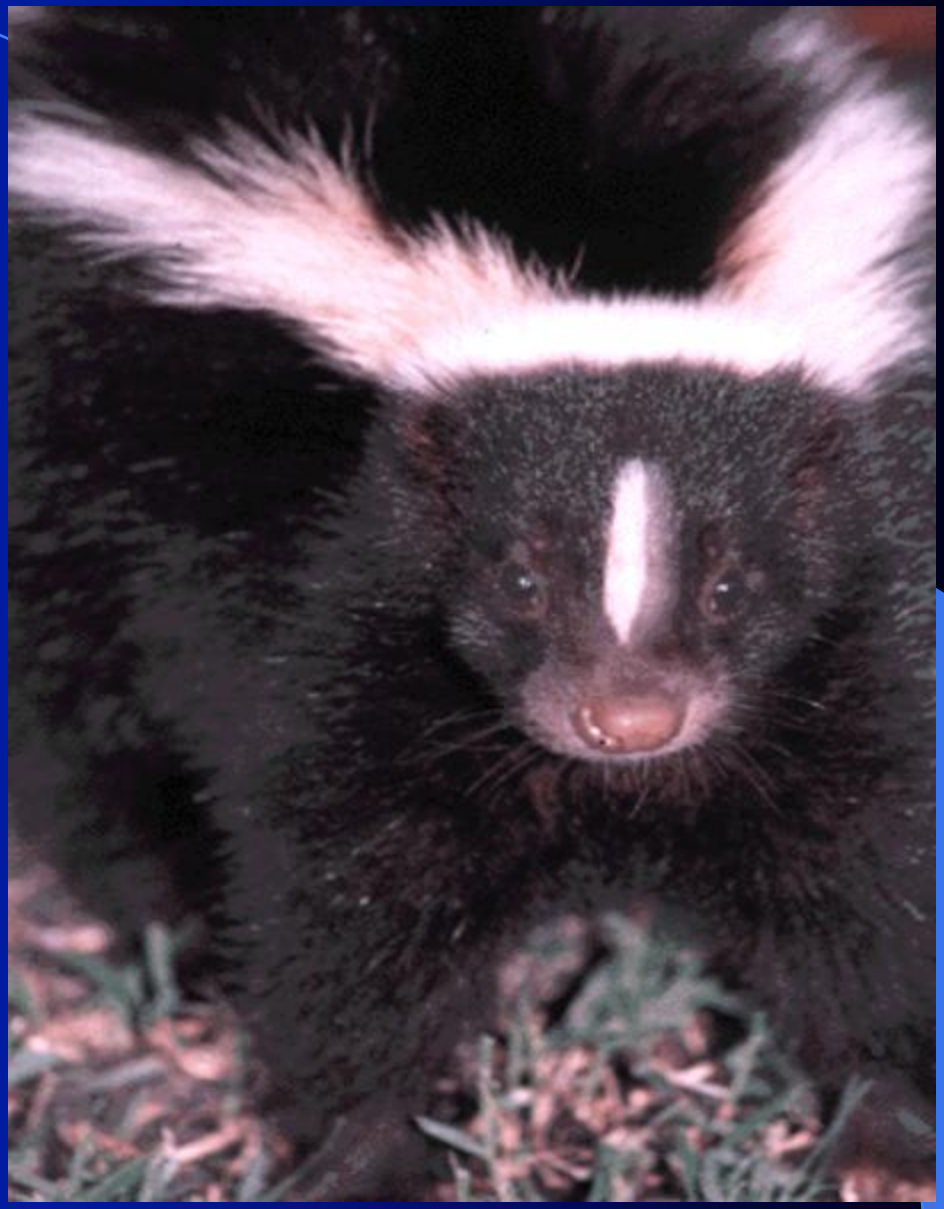
- Speed
- Crypsis (camouflage)
- Aposematic coloration - warning
- Distasteful nature - Monarch butterflies
- Dangerous nature - wasps, bees
- Mimicry
- Group living

Aposematic Coloration

Cryptic Coloration

Dangerous Nature

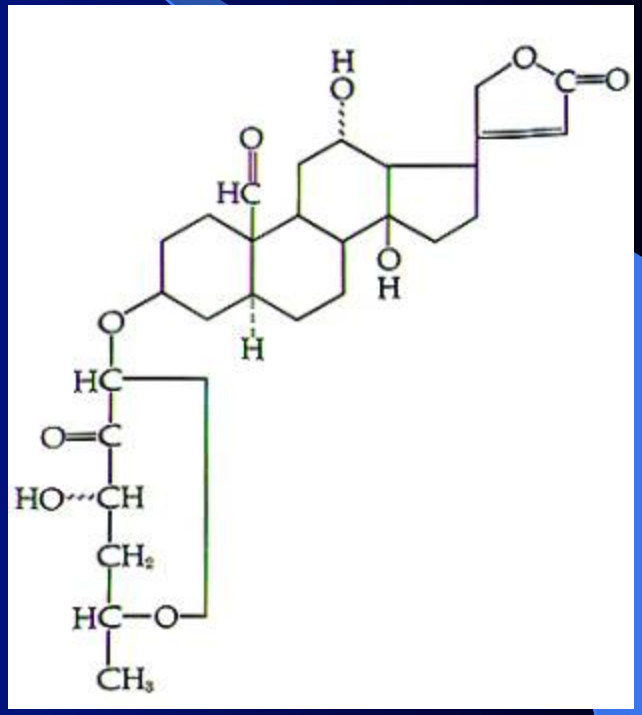
Distasteful Nature



Mimicry

Mimicry

Plant Toxins



Mutualism

Is an interaction between two species where both benefit (often co-evolved relationship)

Examples:

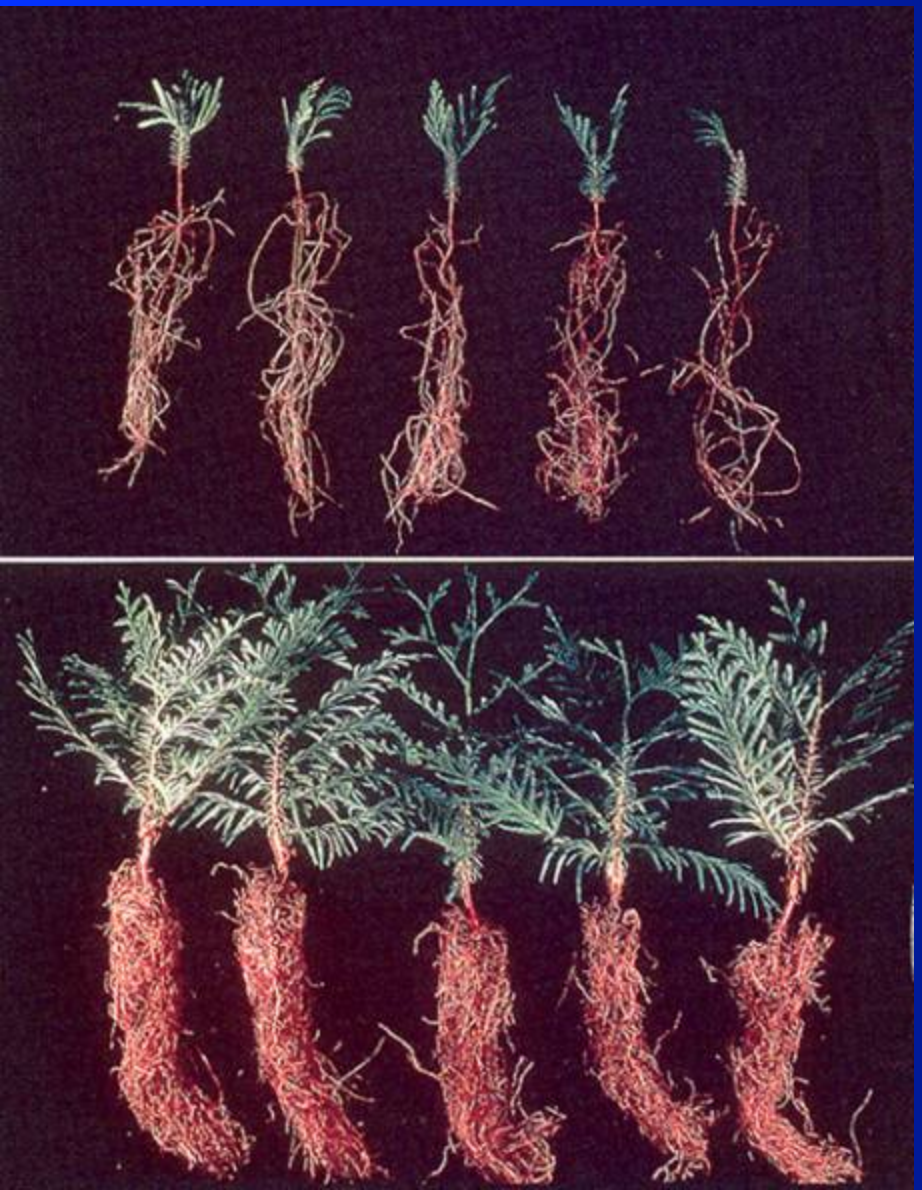
Lichens: fungi/algae (or cyanobacteria). Protected environment in exchange for photosynthates.

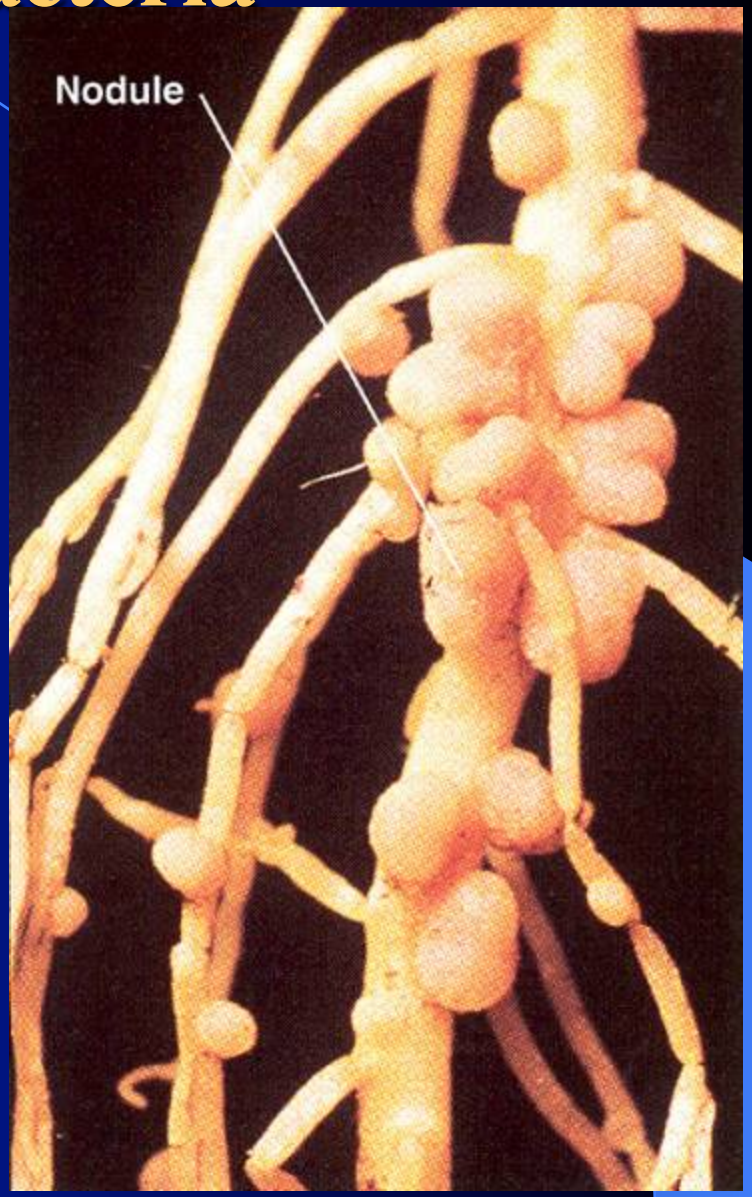
Mycorrhizae: plants/fungi make connections with the roots of plants. Get photosynthates in return for nutrients, especially phosphorous.

Rhizobium bacteria/some plants: nitrogen/photosynthates

Lichens

Rhizobium bacteria





Commensalism

Interaction wherein one species benefits, while the other is unaffected.

Examples:

Cattle and cattle egrets

Eyelash mites

Cattle Egrets

Eyelash Mites

Benefits from Diversity

Utilitarian

- Food
- Drugs and Medicines

Aesthetic

- Recreation/tourism

Ecological

- Community Stability

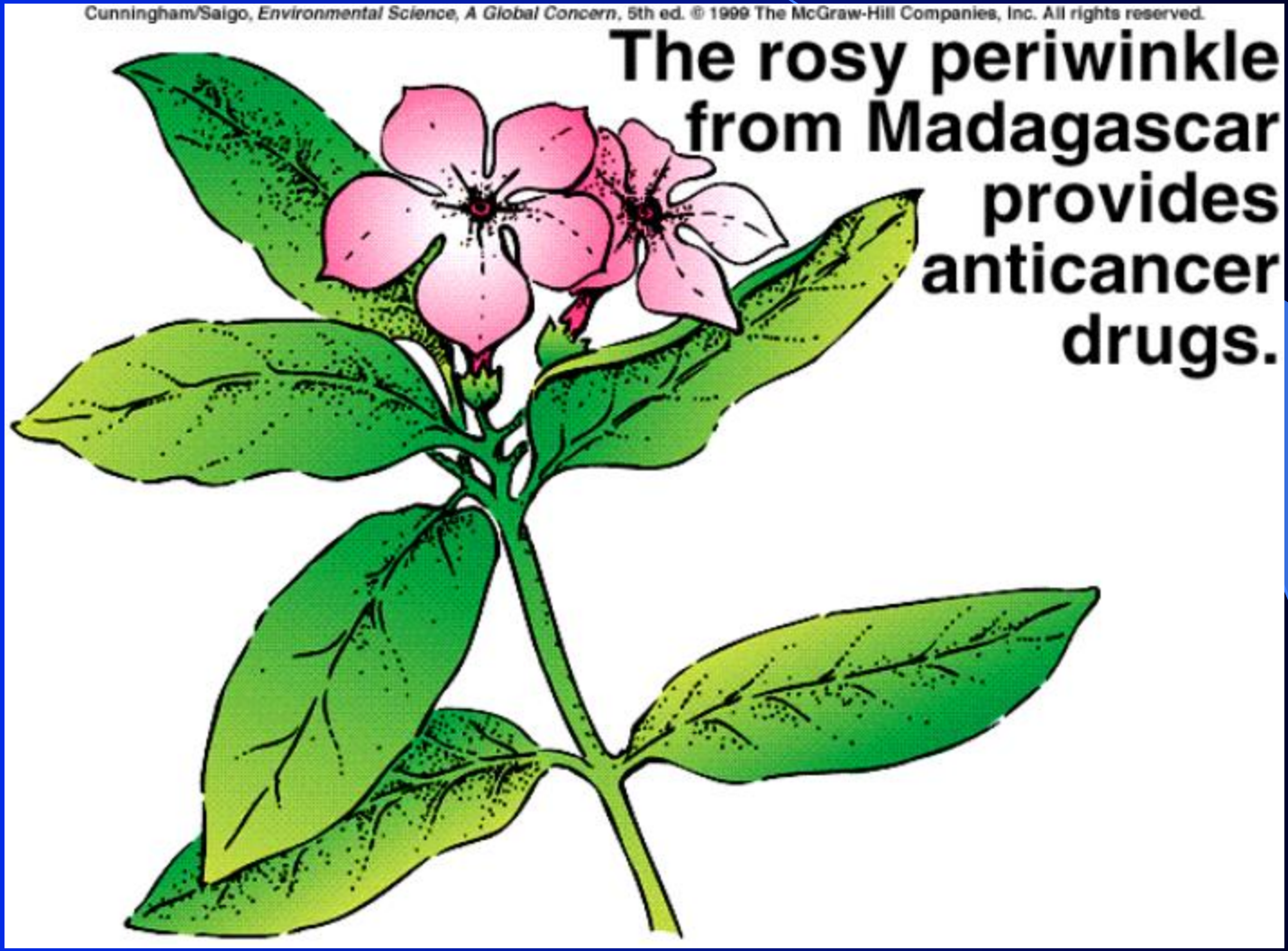
Moral

Diverse Food Sources

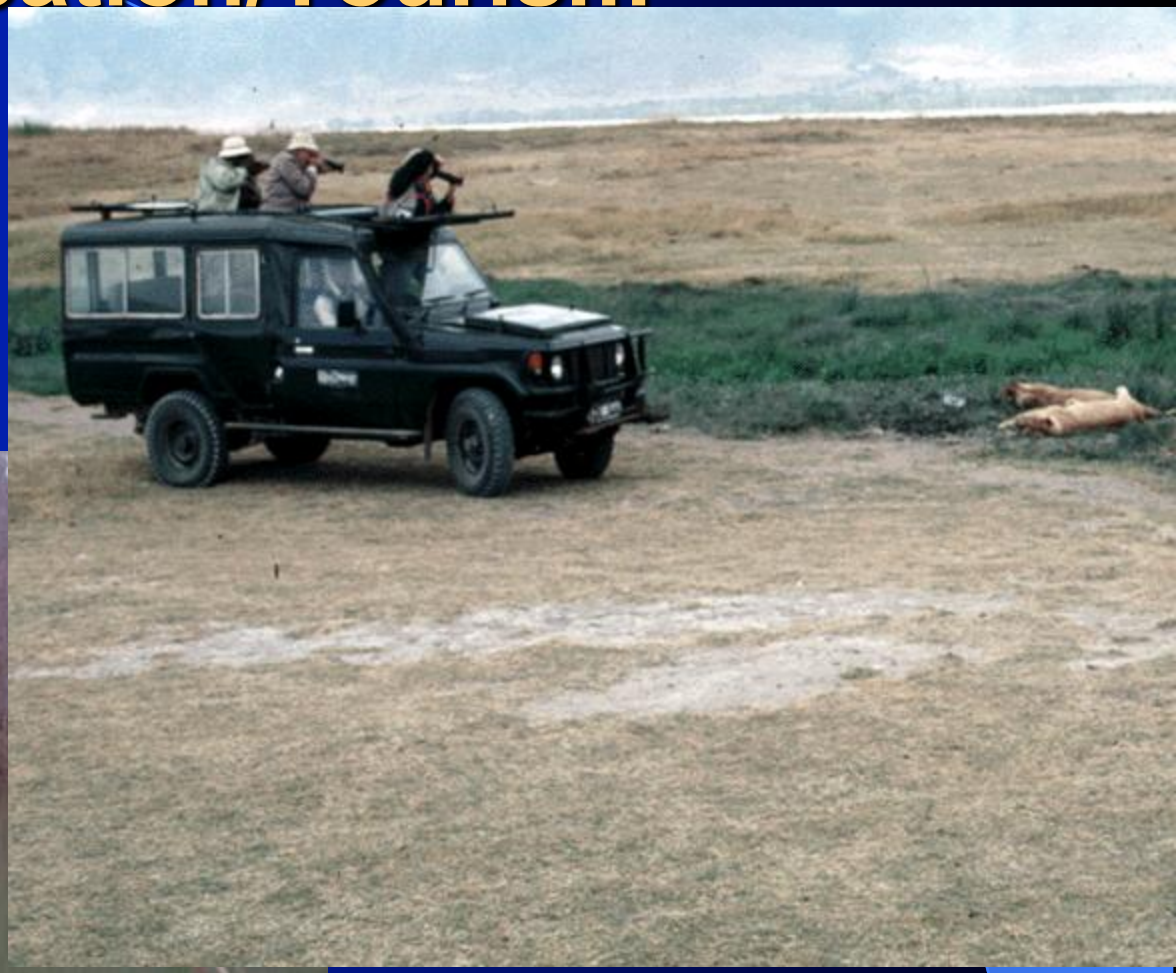
Drugs and Medicines

Some natural medicinal products		
Product	Source	Use
Penicillin	Fungus	Antibiotic
Bacitracin	Bacterium	Antibiotic
Tetracycline	Bacterium	Antibiotic
Erythromycin	Bacterium	Antibiotic
Digitalis	Foxglove	Heart stimulant
Quinine	Chincona bark	Malaria treatment
Diosgenin	Mexican yam	Birth-control drug
Cortisone	Mexican yam	Anti-inflammation treatment
Cytarabine	Sponge	Leukemia cure
Vinblastine, vincristine	Periwinkle plant	Anticancer drugs
Reserpine	Rauwolfia	Hypertension drug
Bee venom	Bee	Arthritis relief
Allantoin	Blowfly larvae	Wound healer
Morphine	Poppy	Analgesic

Drugs and Medicines



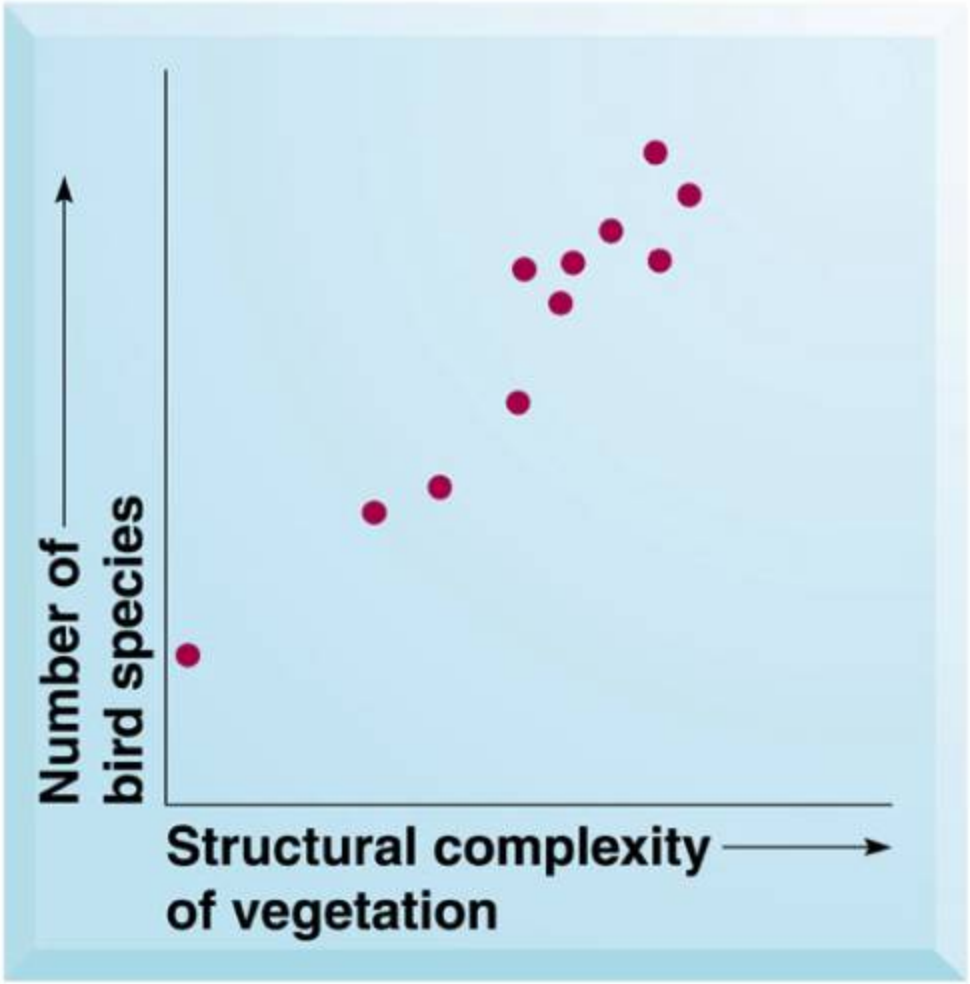
Recreation/Tourism



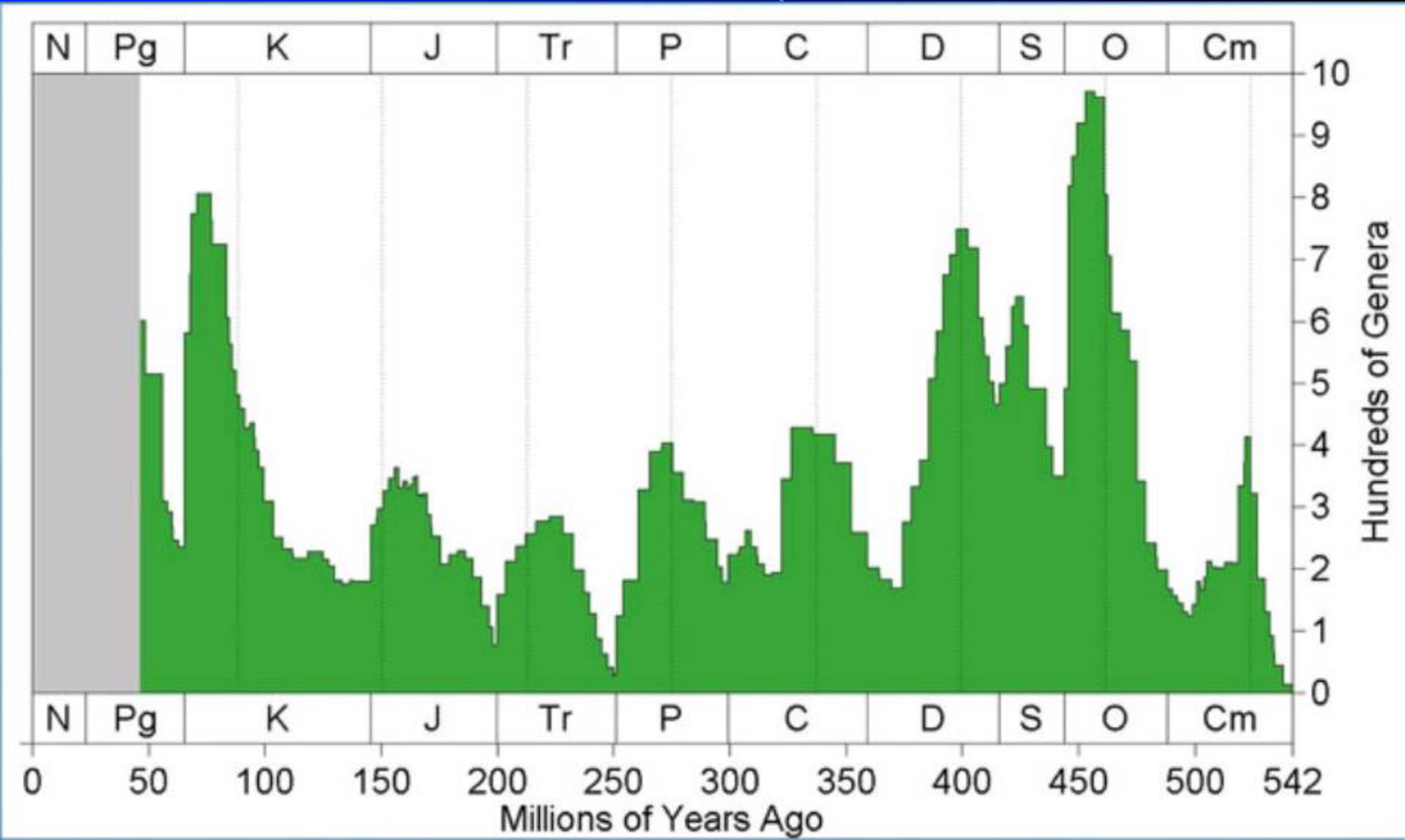
Determinants of Species Diversity

1. Abundance of ecological niches
2. Dominance of individual species
3. Environmental stress of habitat

Effect of Abundance of Niches



Periodic Disasters?



Succession

Succession is the directional changes in the community through time. Changes occur because species alter the soil, shelter, humidity, etc. It results from the differential ability of organisms to colonize disturbed areas and from environmental changes.

Move from *pioneer* community through successional communities to a *climax* community.

Primary Succession

Primary succession is at a new, sterile site.

Conditions that may cause primary succession are glaciers, winds, fires, or volcanoes producing glacial moraines, dunes, and lava fields. The key point is that the soil has been disturbed.

Indiana Dunes

Glacial Moraine

Mount Saint Helens

Before the eruption the ridges north of the volcano were shrouded in old-growth Pacific silver fir and mountain hemlock forests. The forest in this photo is growing on the site of the now popular Windy Ridge viewpoint, four miles (6 km) northeast of the volcano. The signboard marks a vegetation plot, one of only a few places where the composition of pre-eruption vegetation was recorded at an individual species level. [M. Hemstrom, USDA Forest Service, 1979]

A repeat photo of the same location shows the scouring effects of the 300 mph, stone-filled blast that not only toppled the trees but also ripped them from the ground (blast direction is from left to right). The blast stripped the branches from the trees and deposited a jumbled pile of logs on the far side of the ridge.
[USDA Forest Service, 1980]

Mount Saint Helens

Prior to the eruption high mountain lakes like Obscurity Lake, 10 miles north of Mount St. Helens, were characteristically clear due to extremely low levels of dissolved nutrients.
[USDA Forest Service, 1978]

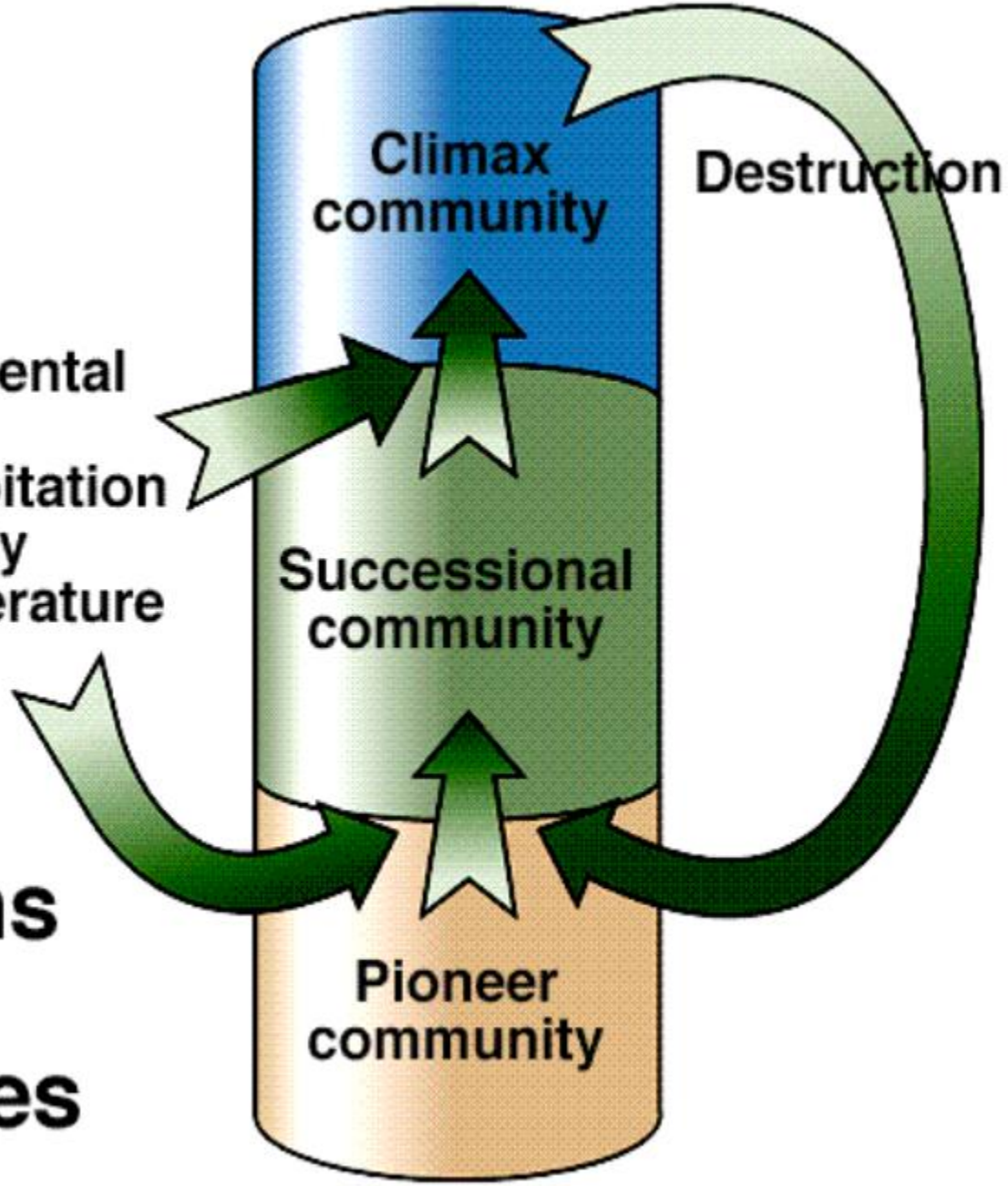
Lake Obscurity
10 miles N

The same view after the eruption shows the extent of eruption damage to the forest surrounding Obscurity Lake. Note the large quantity of volcanic ash that was eroded from adjacent hillsides and deposited on large deltas at the mouth of inlet streams.
[USDA Forest Service, 1980]

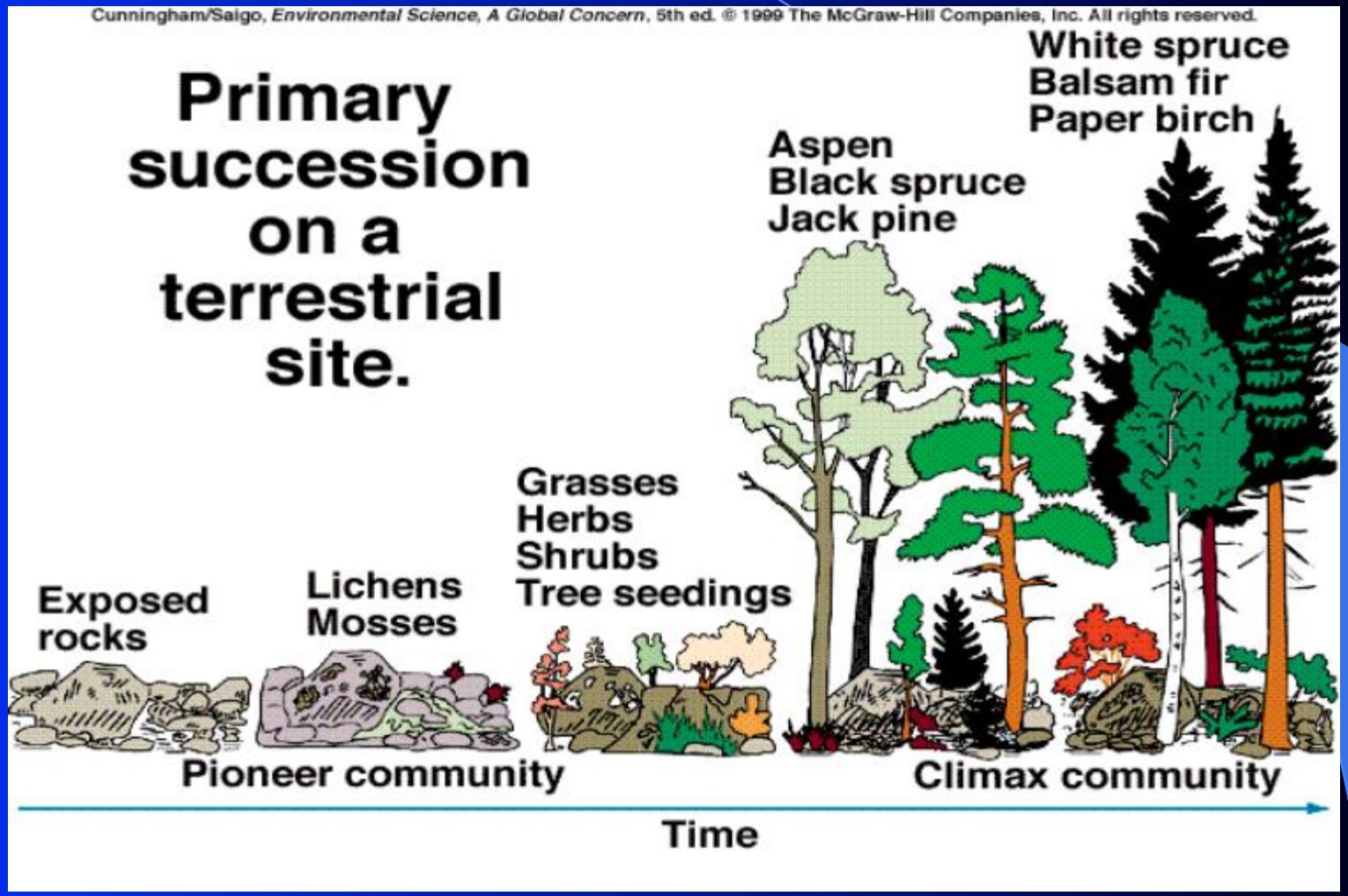
Secondary Succession

Secondary succession is recovery of a disturbed site back to a climax community. The soil remains relatively intact (e.g., cause of secondary succession is cutting oak trees from a forest)

Kinds of Ecosystems and Communities



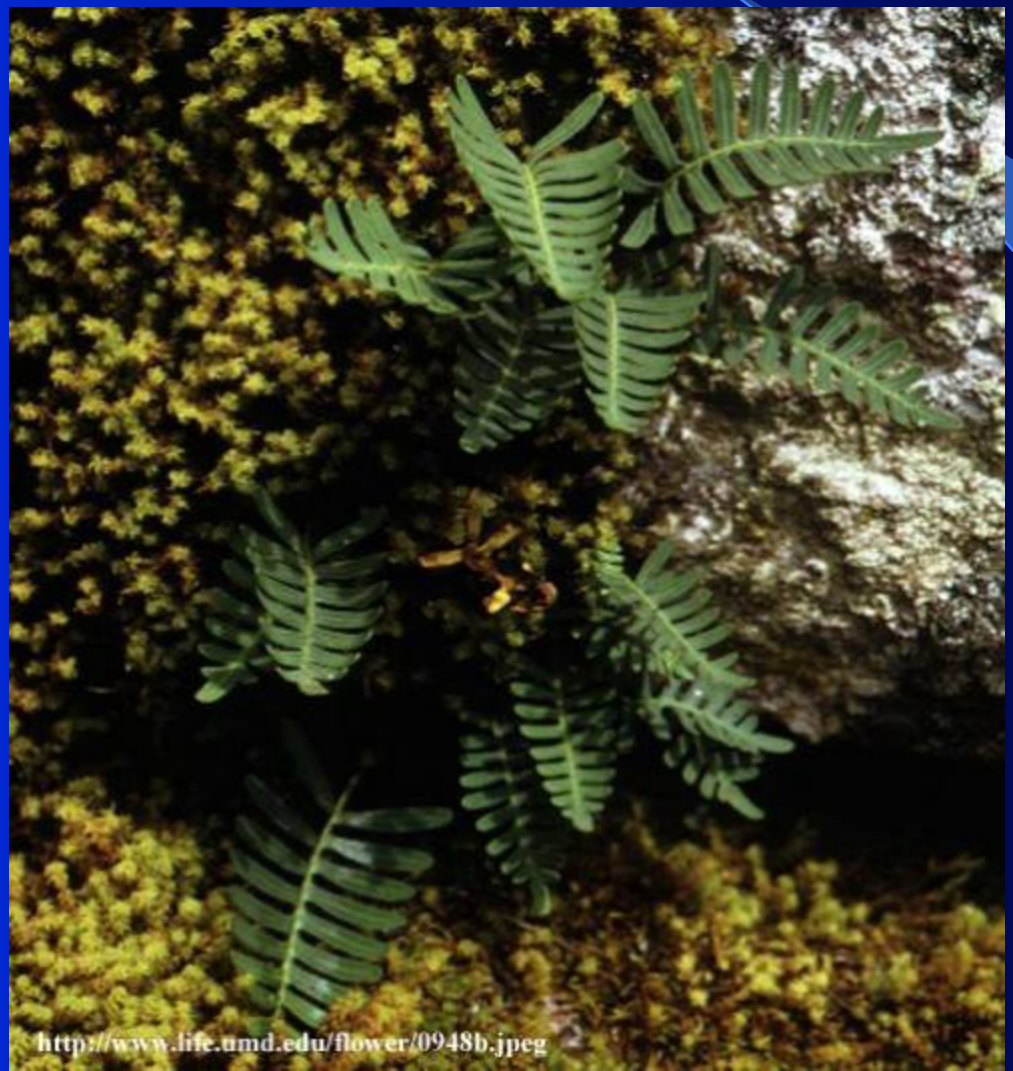
Progression



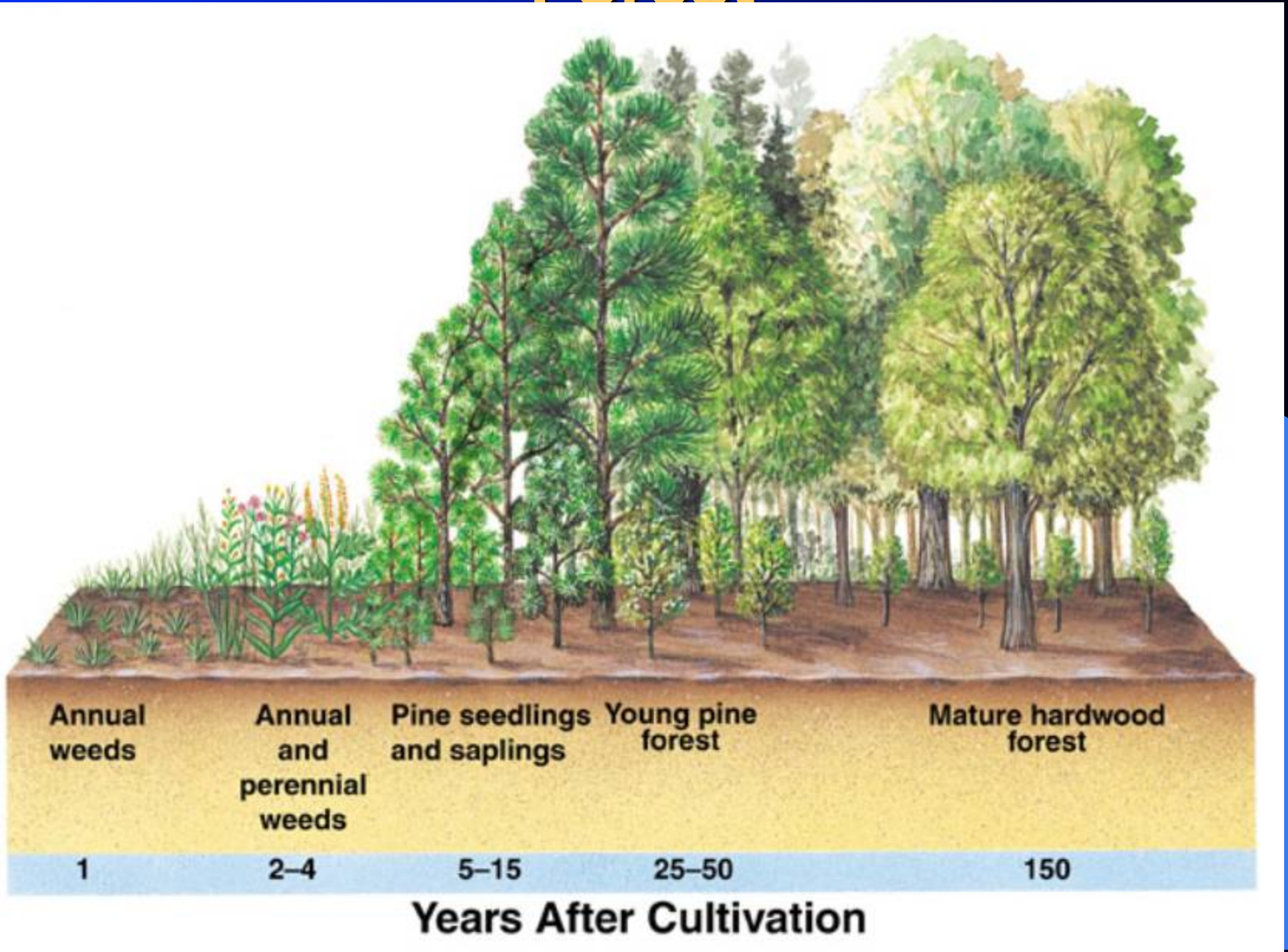
Examples of Progression

Lichens and Mosses of Early Succession

Plants of Middle Succession



Timeline for Hardwood Climax Forest



Succession Often is the Result of Human Intervention


http://csssrvr.entnem.ufl.edu/~walker/oldfgall.html


http://csssrvr.entnem.ufl.edu/~walker/oldfgall.html


http://csssrvr.entnem.ufl.edu/~walker/oldfgall.html


http://csssrvr.entnem.ufl.edu/~walker/oldfgall.html

Succession May Be Facilitated

"**Nurse plants**" may often facilitate the progression toward a climax system.

The idea of facilitating species is important concept for restoration ecology).

Facilitation of One Species by Another

e.g., Saguaro Cactus need nurse plants (mesquite) to shield seeds from consumption and to protect young plants from cold nights.

Question: Does Succession Apply Only to Restoration of Land Ecosystems?

No!! – Aquatic ecosystems go through progressive stages to reach a stable community structure.

Nutrient (Geobiochemical) Cycles

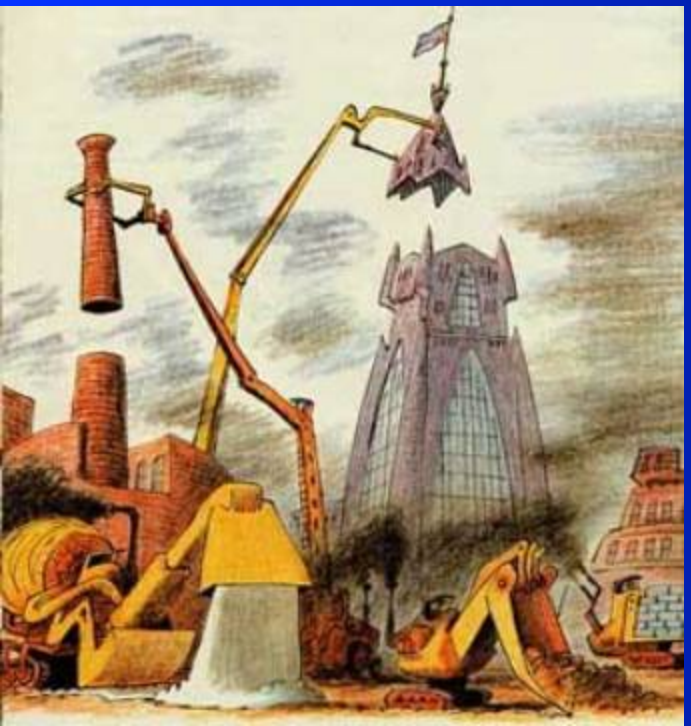
Chapter 6 part 2

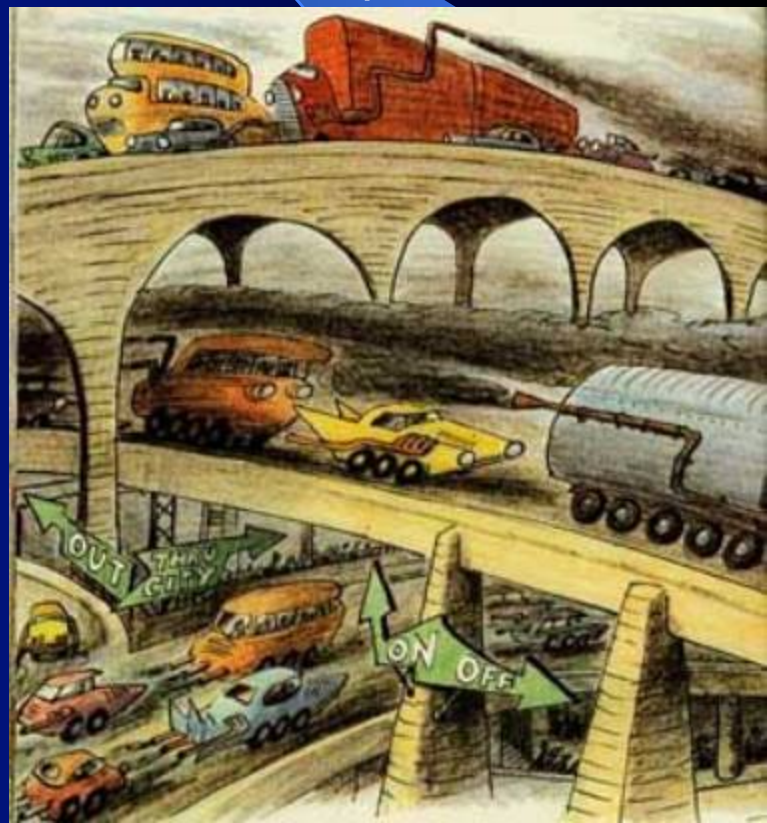
The Underlying Bases of **Abiotic** Changes

Wump World by Bill Peet

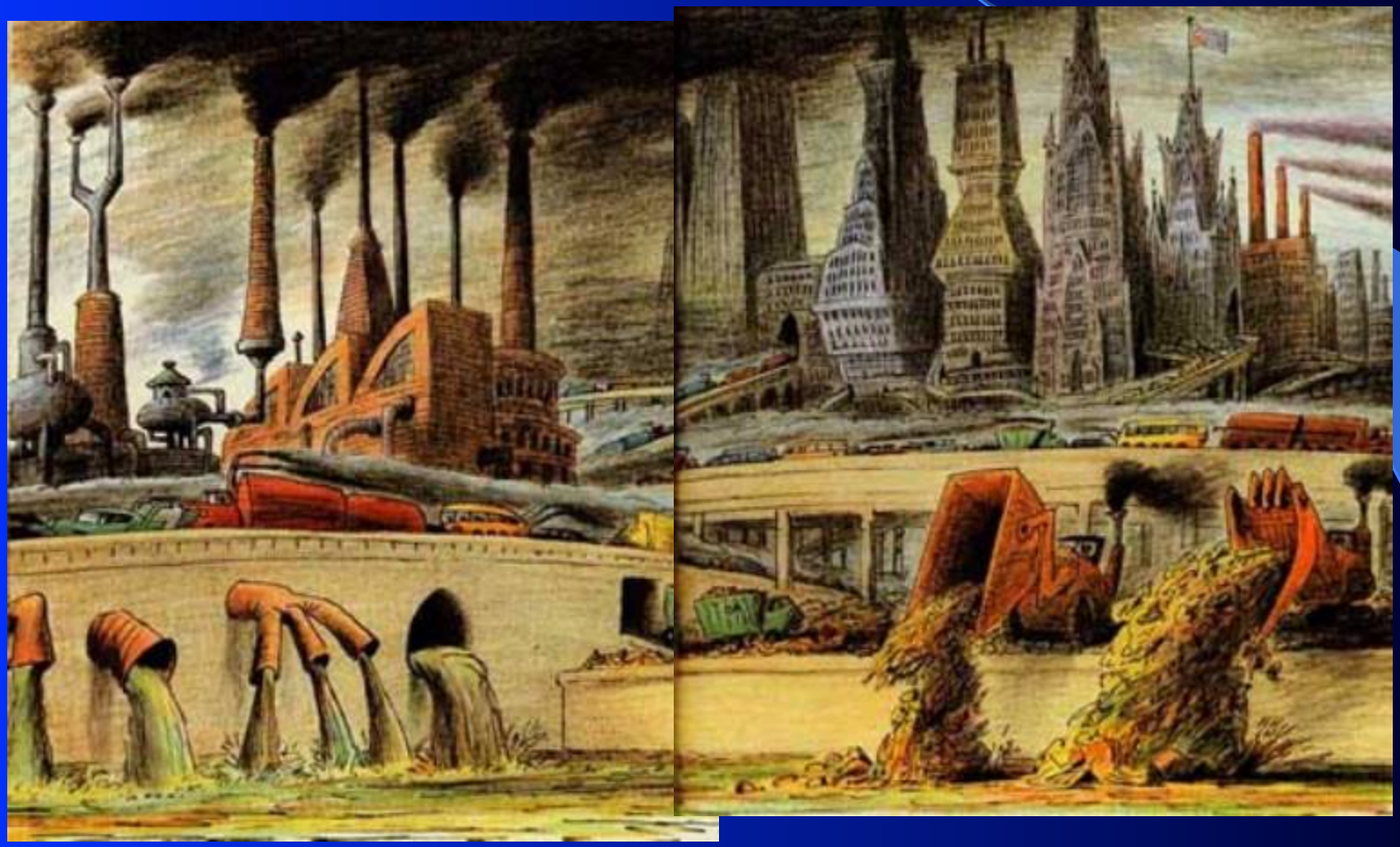
Wump World takes us to a tiny and perfect world, populated only by the gentle and sweet Wumps. But the peace is soon destroyed by the Pollutians, who arrive in strangely primitive looking spaceships. Their intent is anything but primitive though, as the Pollutians are bent on covering every surface of the Wump's world with freeways and skyscrapers.

They've already polluted their own world beyond livability.



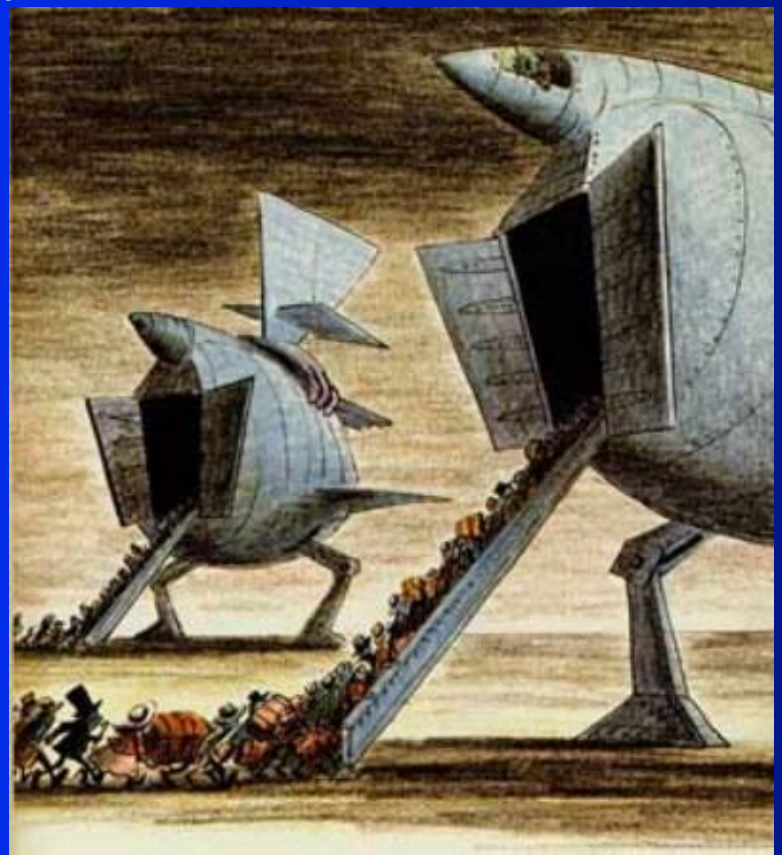


Wump World by Bill Peet



Wump World by Bill Peet

The story moves from the poor little Wumps, shivering underground and cringing at all the noise pollution, to the clueless Pollutians. Soon they dispatch more exploratory spacemen to find a new world, because the Wump World is almost all used up.



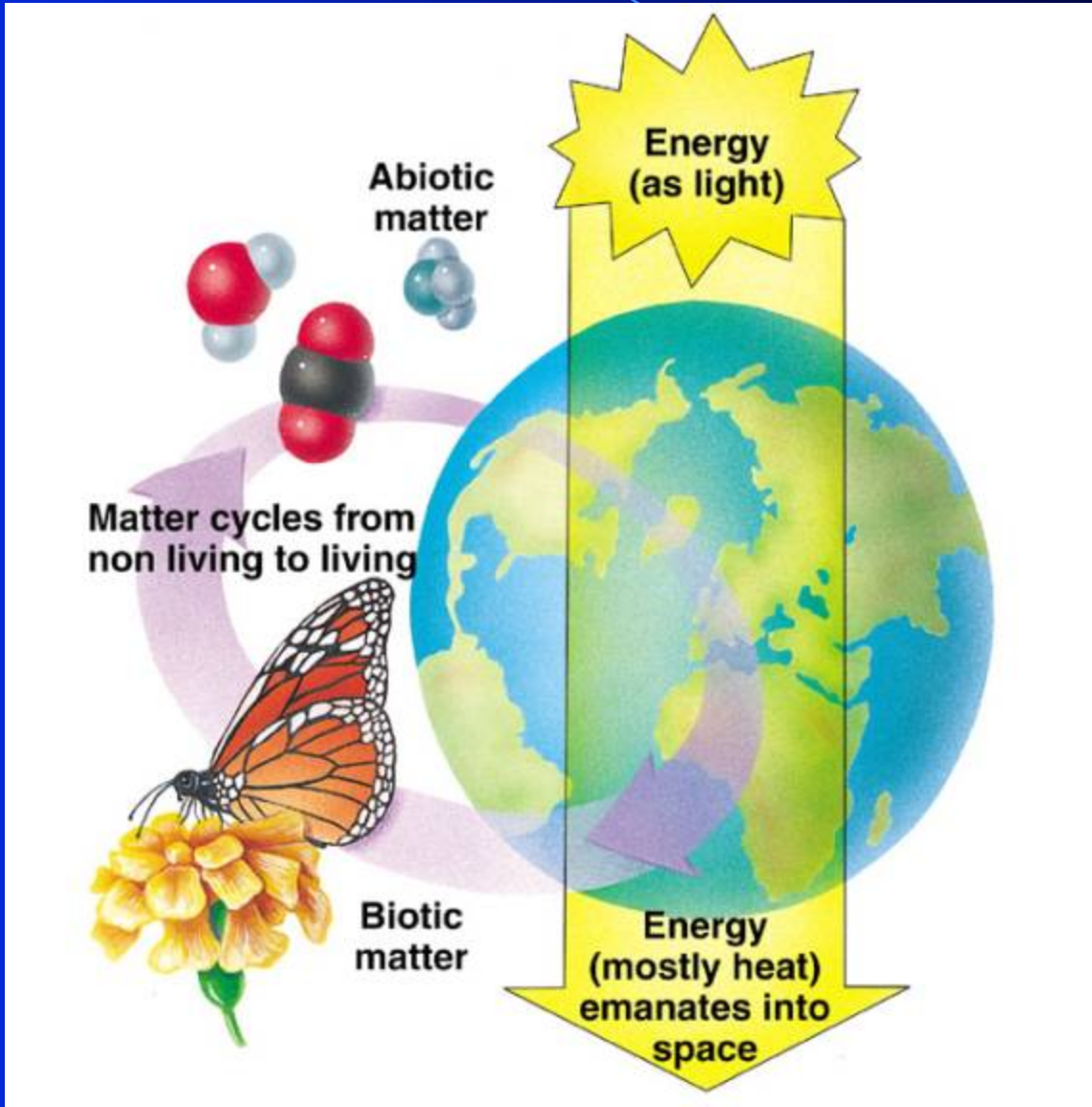
Departure of the Pollutians

Wump World by Bill Peet

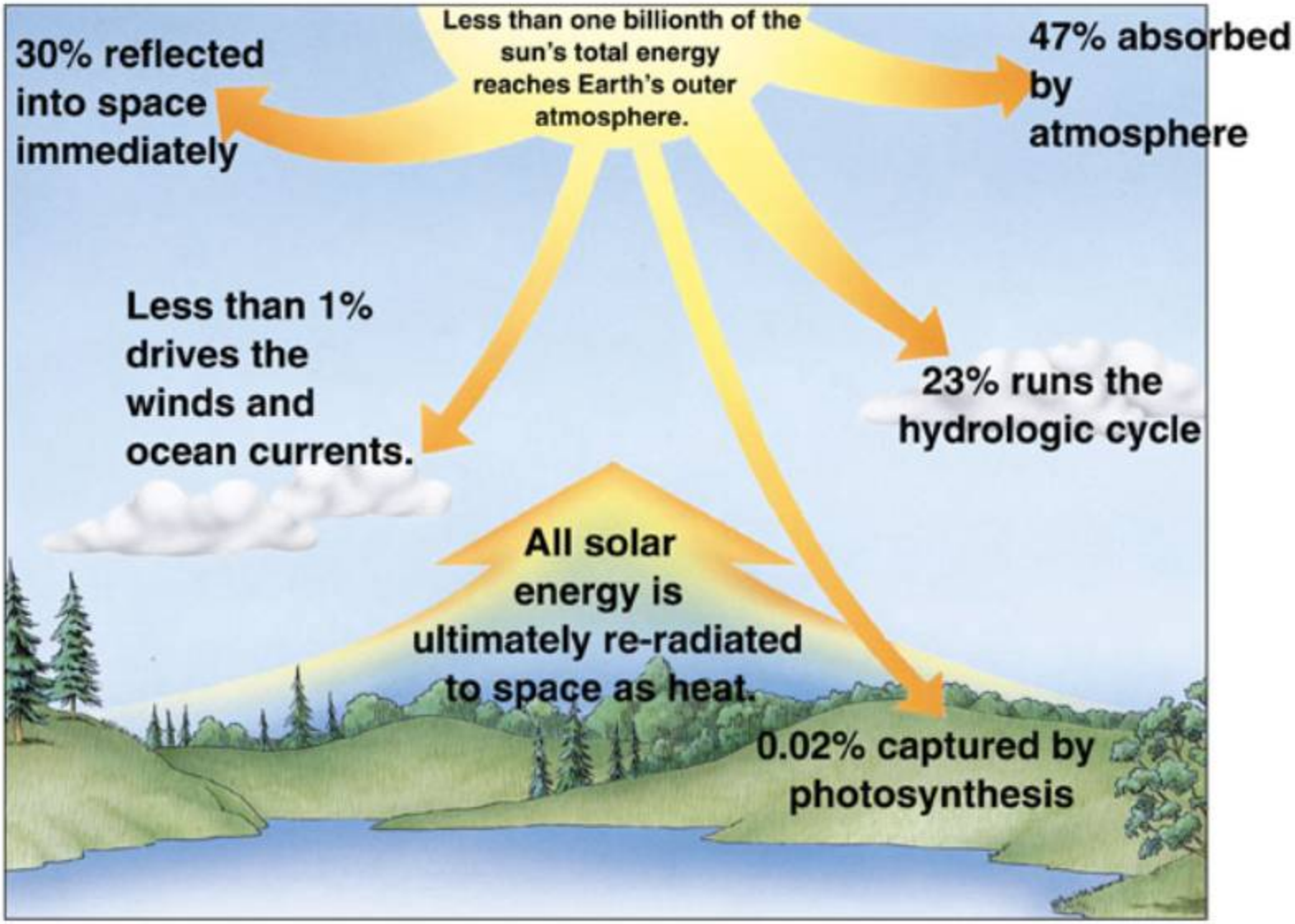
In time the murky skies would clear up and the rains would wash the scum from the rivers and lakes. The tall buildings would come tumbling down and the freeways would crumble away. And in time the green growth would wind its way up through the rubble.

But the Wump World would never be quite the same.

Flow of Energy and Matter



Energy Flow (Review)



Biogeochemical Cycles

Biogeochemical cycles describe the ecosystem by the transfer of elements through the system.

By examining the cycles we can look at the fluxes of nutrients (sources and sinks) and better understand human-caused imbalances.

Biogeochemical Cycles Processes

Regulate nutrients

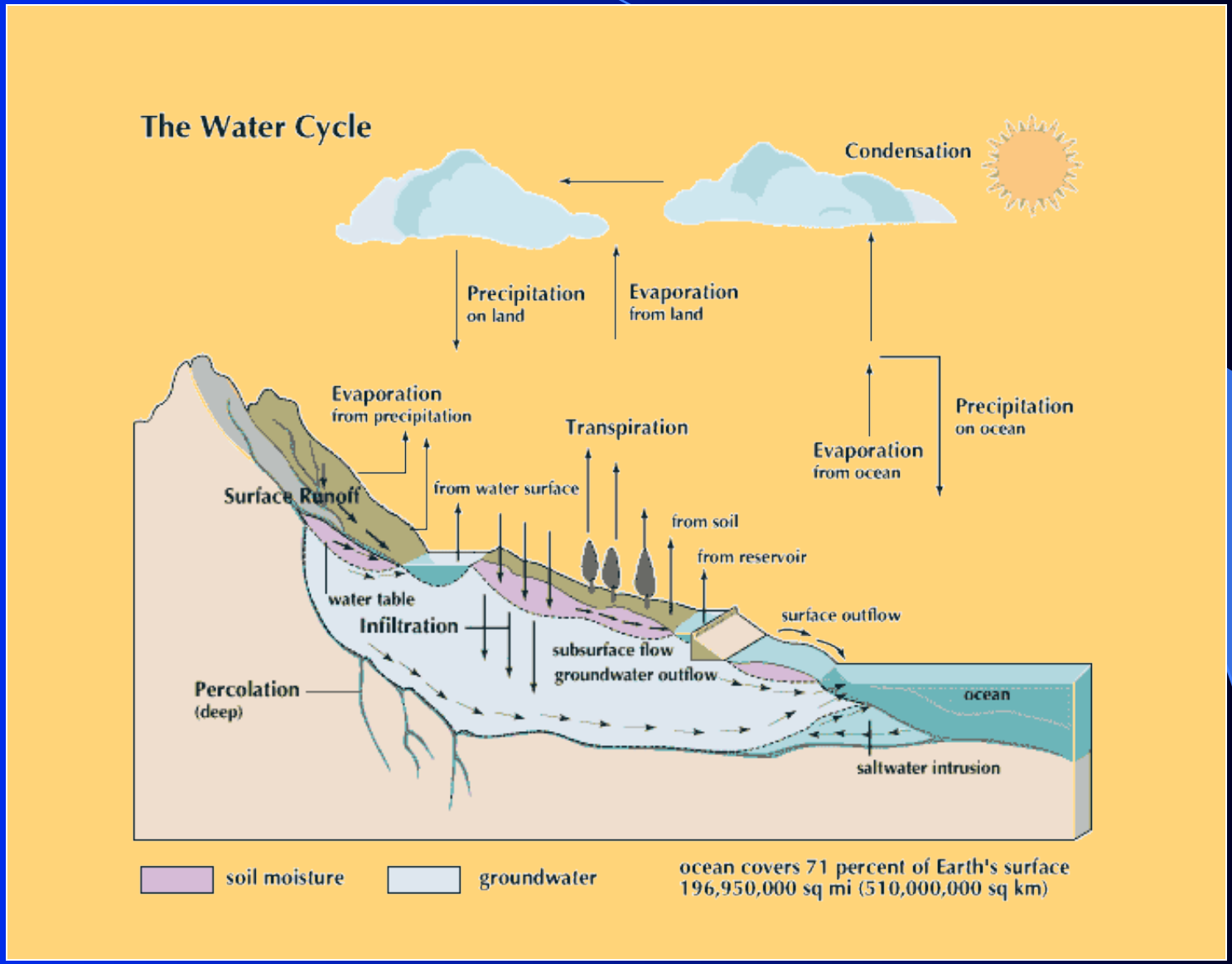
Influence climate stability

Influence the purity of drinking water

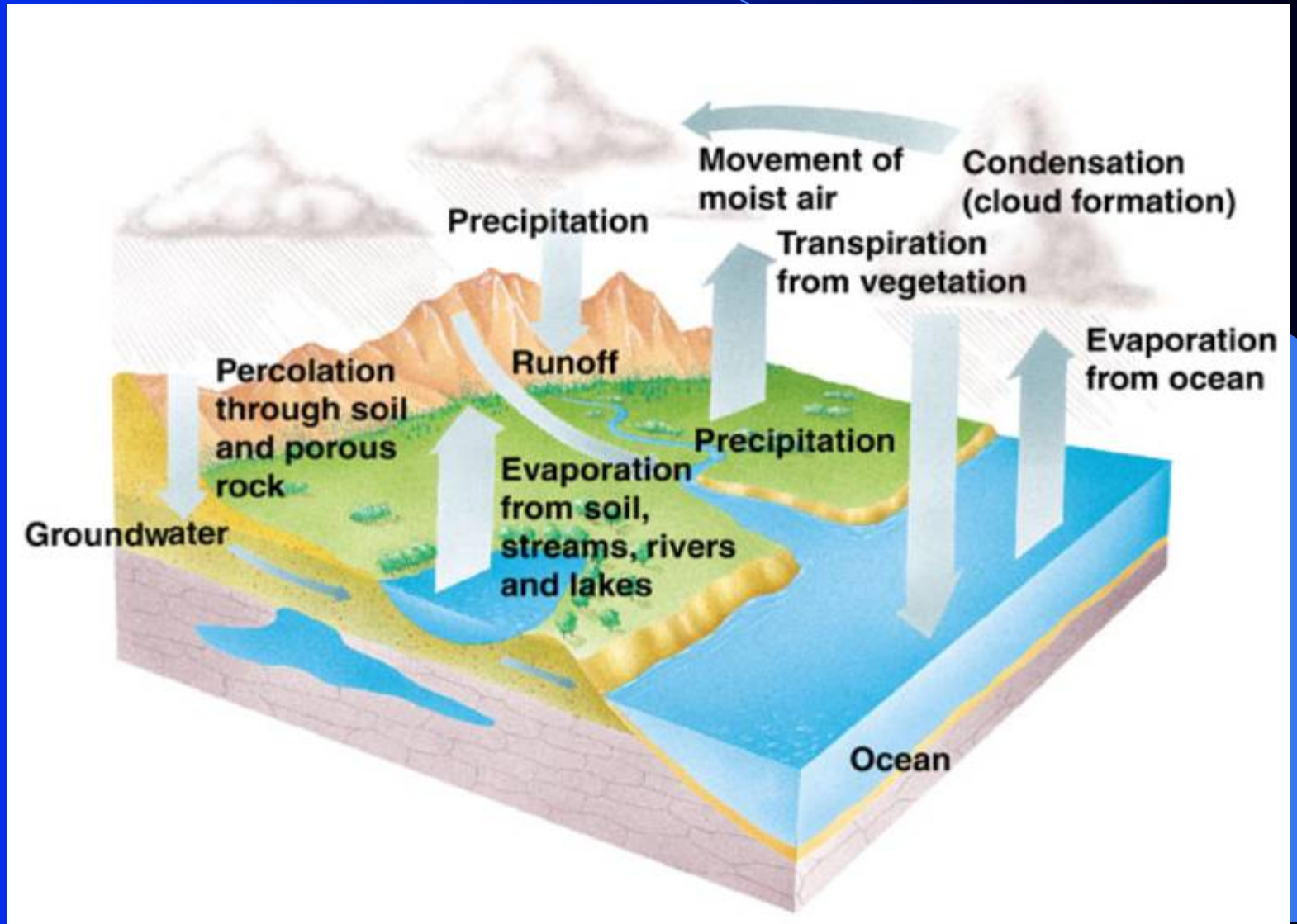
Basic Cycles

1. Hydrologic (water)
2. Carbon
3. Nitrogen
4. Phosphorus
5. Sulfur

Water Cycle


The Water Cycle
Condensation
Precipitation
on land
Evaporation
from land
Evaporation
from precipitation
Transpiration
Precipitation
on ocean
Evaporation
from ocean
Surface Runoff
from water surface
from soil
from reservoir
water table
Infiltration
surface outflow
subsurface flow
groundwater outflow
Percolation
(deep)
ocean
saltwater intrusion
soil moisture
groundwater
ocean covers 71 percent of Earth's surface
196,950,000 sq mi (510,000,000 sq km)

Water Cycle


Movement of moist air
Condensation (cloud formation)
Precipitation
Transpiration from vegetation
Evaporation from ocean
Percolation through soil and porous rock
Runoff
Precipitation
Evaporation from soil, streams, rivers and lakes
Groundwater
Ocean

One estimate of global water distribution:

Estimate of Global Water Distribution – Gleick, 1996			
	Volume (1000 km^3)	Percent of Total Water	Percent of Fresh Water
Oceans, Seas, & Bays	1,338,000	96.5	-
Ice caps, Glaciers, & Permanent Snow	24,064	1.74	68.7
Groundwater	23,400	1.7	-
Fresh	(10,530)	(0.76)	30.1
Saline	(12,870)	(0.94)	-
Soil Moisture	16.5	0.001	0.05
Ground Ice & Permafrost	300	0.022	0.86
Lakes	176.4	0.013	-
Fresh	(91.0)	(0.007)	0.26
Saline	(85.4)	(0.006)	-
Atmosphere	12.9	0.001	0.04
Swamp Water	11.47	0.0008	0.03
Rivers	2.12	0.0002	0.006
Biological Water	1.12	0.0001	0.003
Total	1,385,984	100.0	100.0

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Carbon Cycle/Global Warming Affect the Water Cycle

Increased temperature (carbon dioxide) → more evaporatoin→ increased precipitation, runoff, and soil moisture.

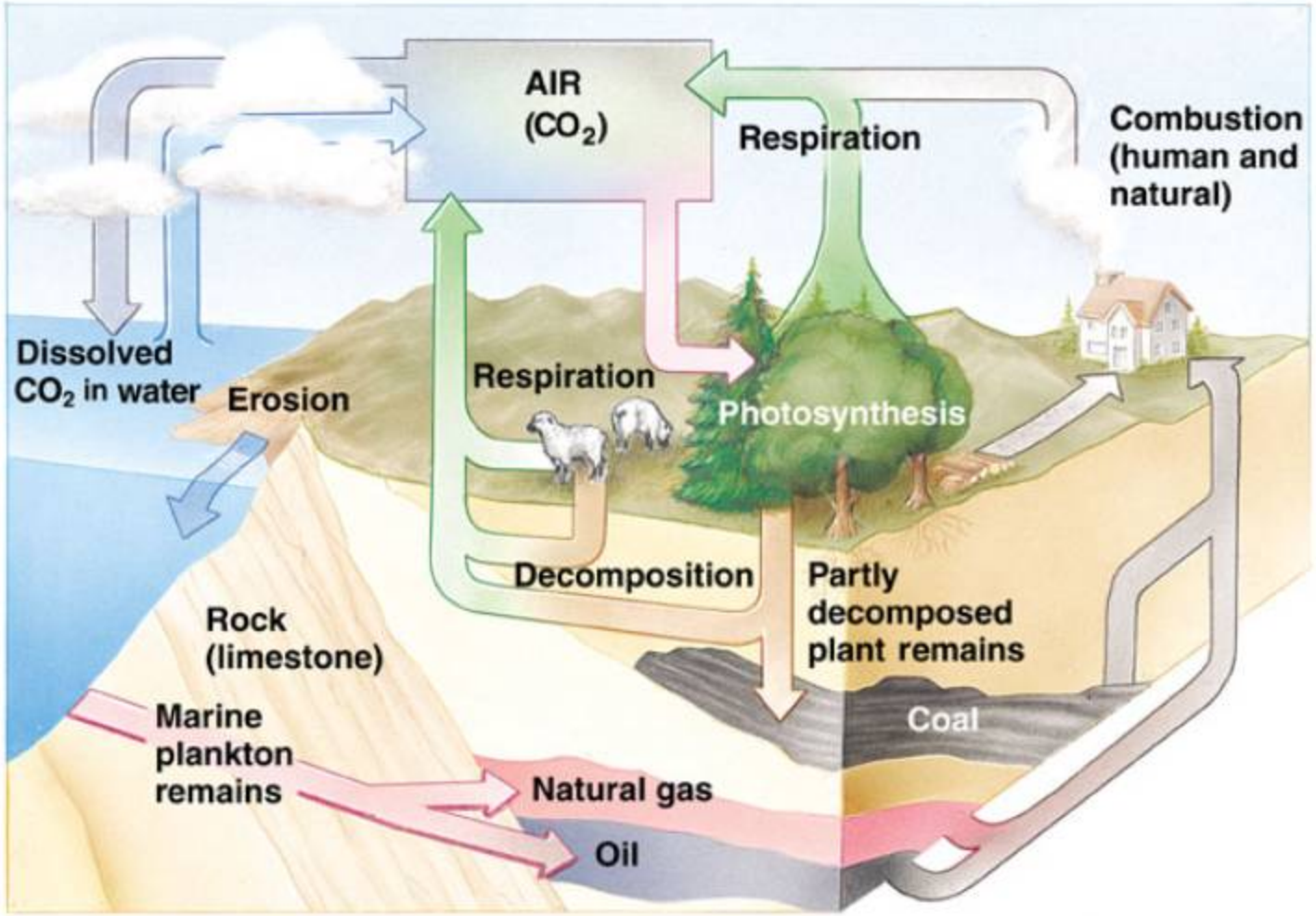
Feedback from increased temp:

Increased cloud cover → (1) reflects light back into the atmosphere, so decreased temp.

Increased cloud cover → (2) water vapor absorbs heat in the atmosphere, so increased temp.

Carbon Cycle

Raven/Berg, Environment, 3/e
Figure 6.2



Carbon Cycle

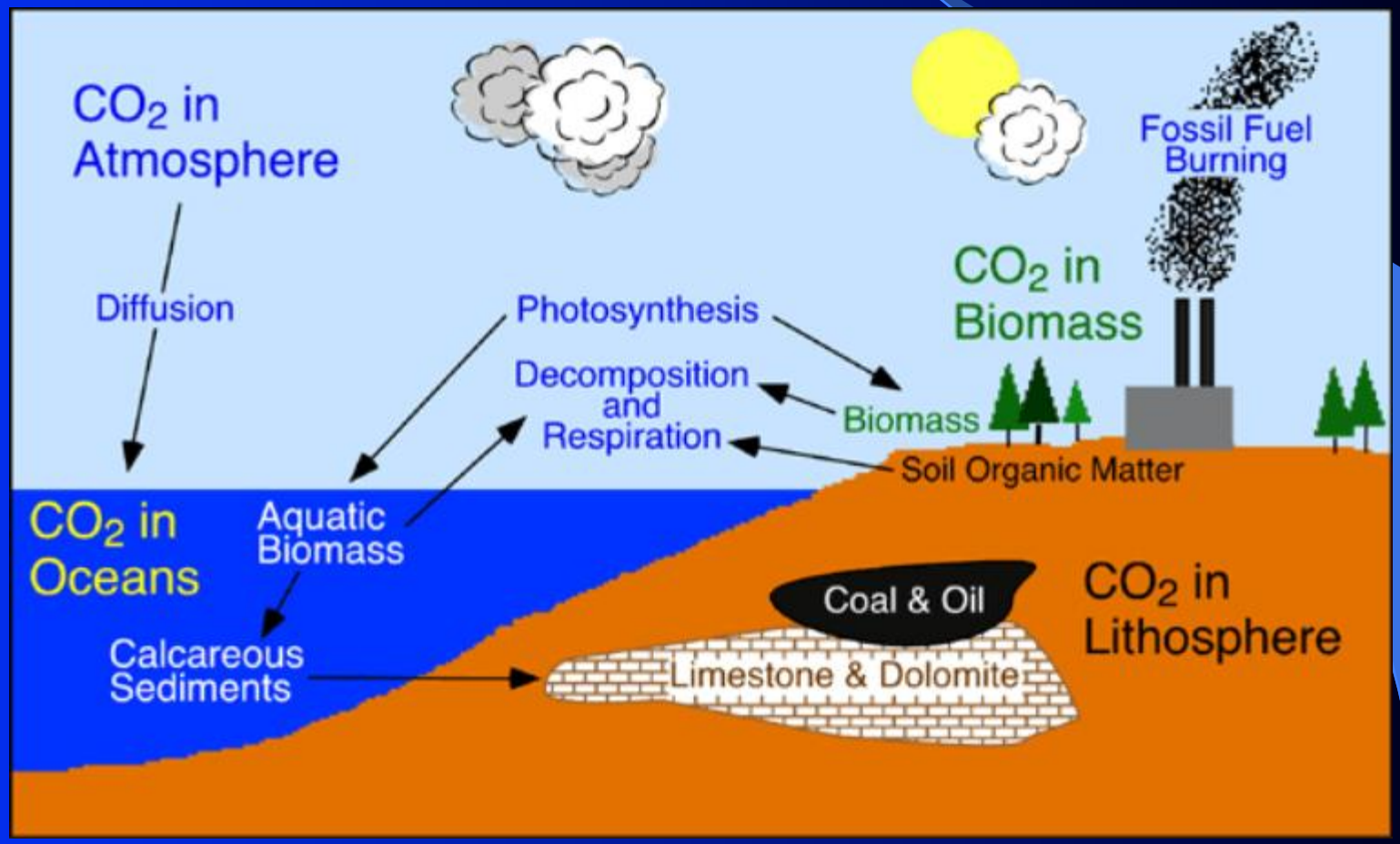
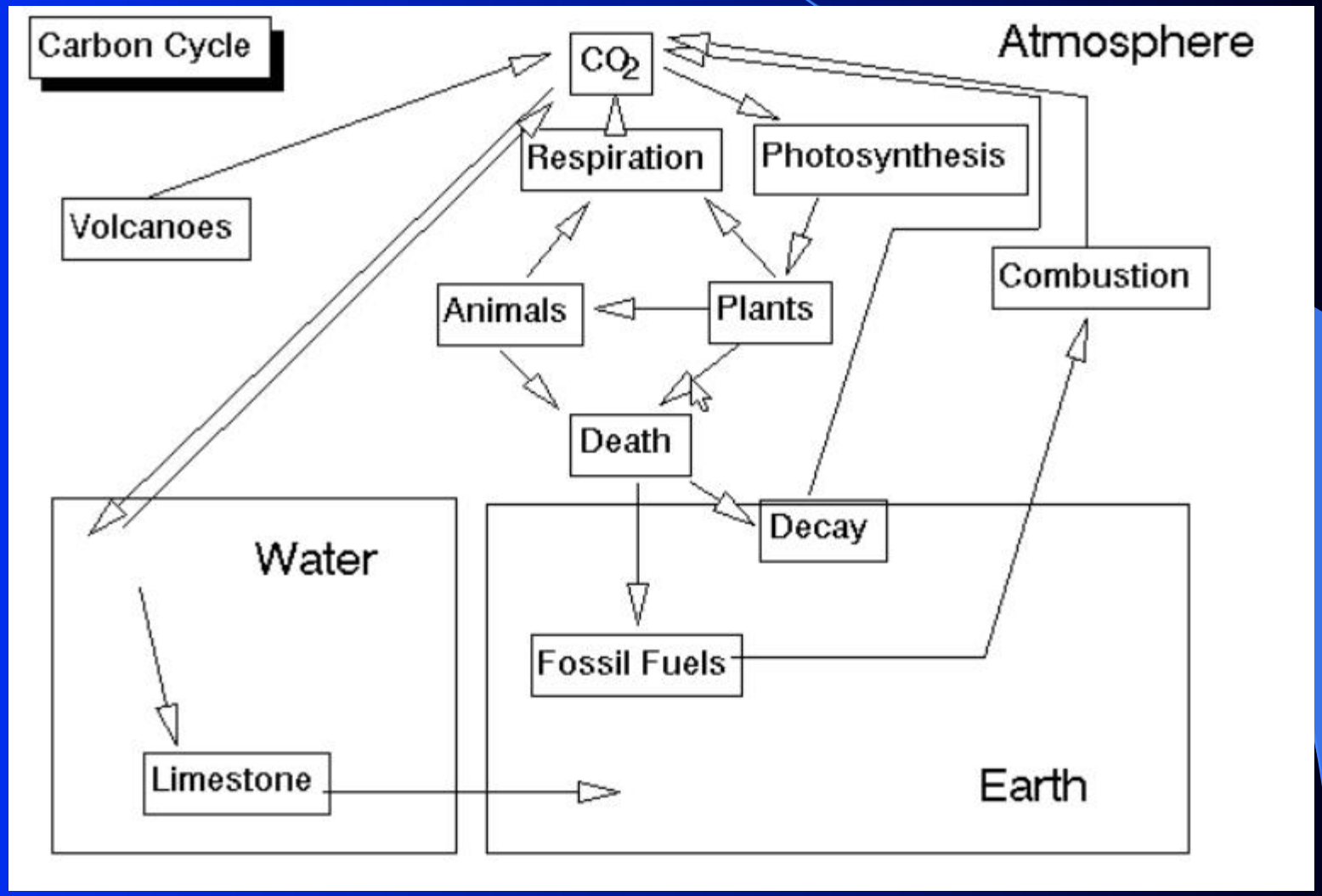


Diagram of Carbon Cycle



Relevance of Carbon Cycle to Climate Change

CO_2 in atmosphere is increasing 0.4% a year (= 40% in 100 yr.)

Increasing CO_2 causes increased temperatures. (Greenhouse effect)

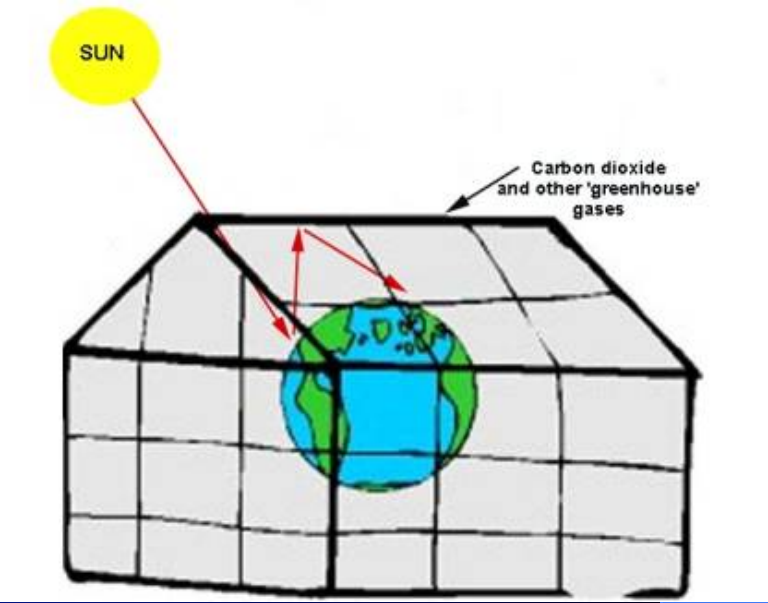
Non-water captured Heat captured by the atmosphere:

- **CO_2 = 50%**
- CH_4 = 20%
- CFCs = 15%
- NO_2, H_2O, O_3 = 15%

Light

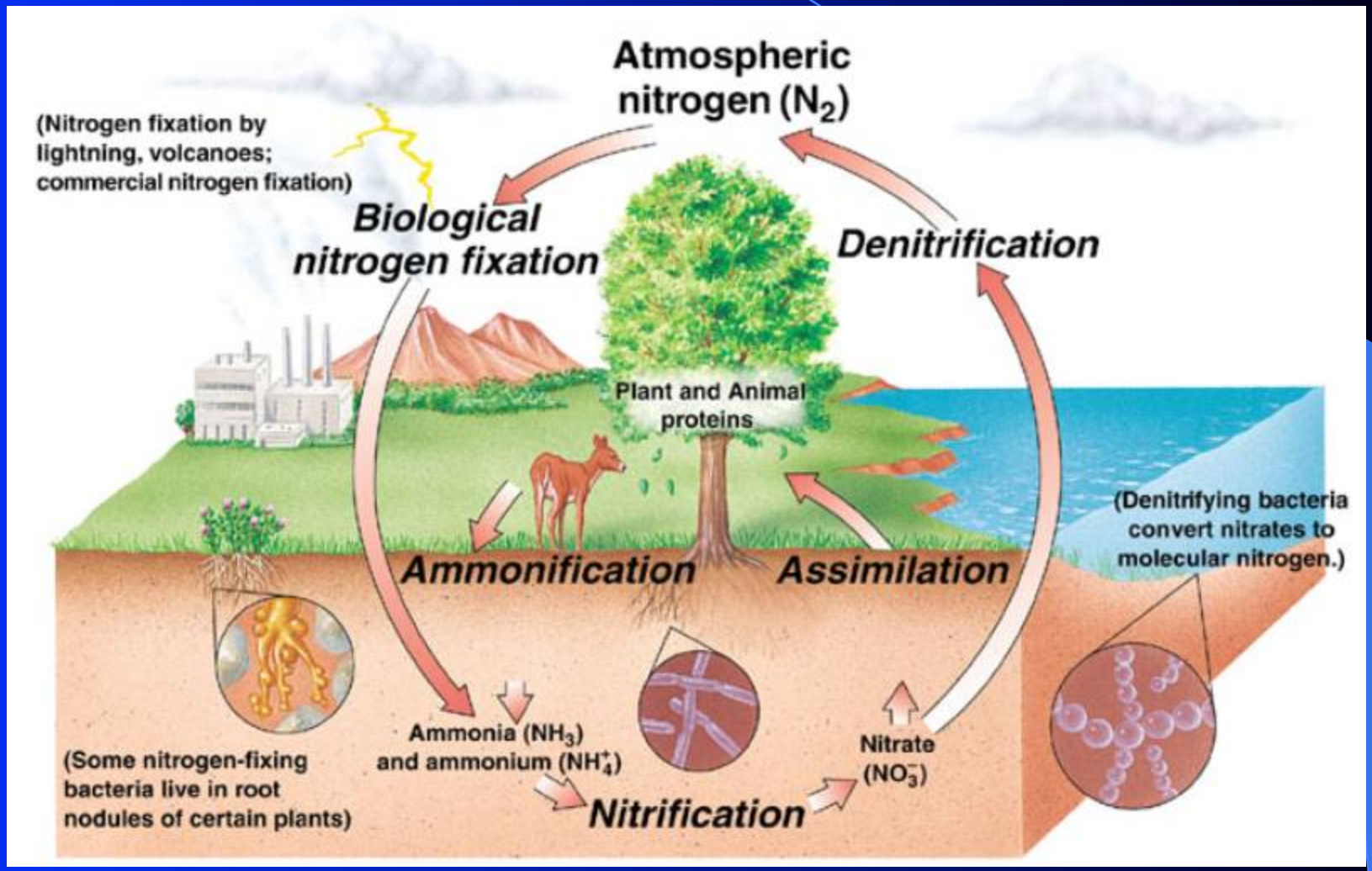
Ultraviolet light is absorbed by ozone.

Visible light passes through atmosphere, then it is ***absorbed*** by earth and water, re-radiated as direct heat or **infrared light** (which also may be absorbed by CO_2, CH_4 , or H_2O to produce heat) which contributes to the **greenhouse effect**.

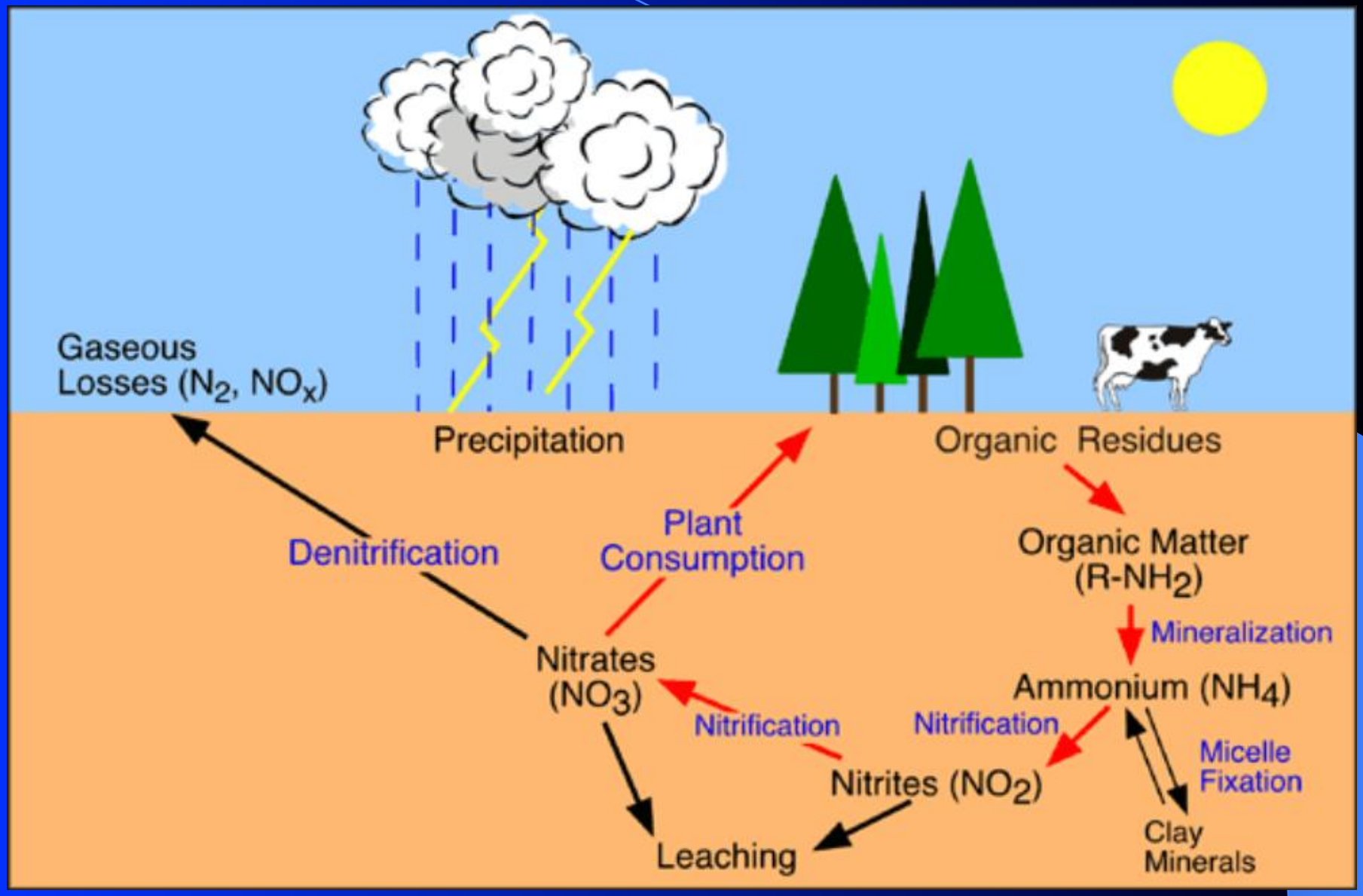


Light doesn't cycle – it is in balance.

Nitrogen Cycle



Nitrogen Cycle



Effects of Increased Nitrogen

1. Loss of soil nutrients (calcium, potassium)
2. Acidification of rivers and lakes (fertilizers and combustion of coal).
3. Increases nitrogen oxides in the atmosphere

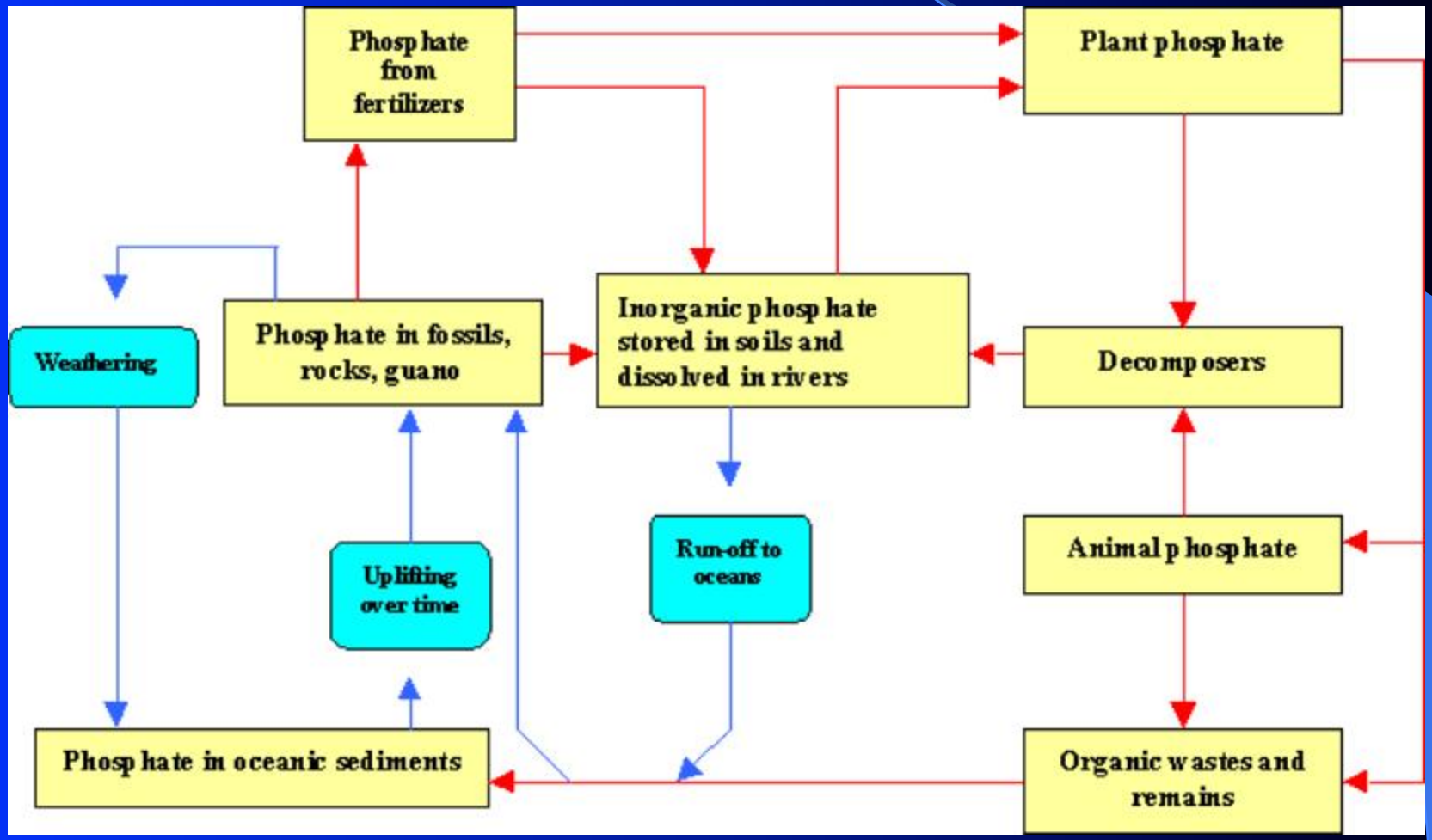
   (greenhouse gas—global warming).

   (reduce ozone—increasing UV penetration).

Effects of Increased Nitrogen

4. Aids in spreading weeds into nitrogen poor areas (+Eutrophication of lakes, ponds, streams).
5. Increasing nitrogen increases carbon fixation (linked to carbon cycle).
6. Increasing acidification increases weathering (increases rate of phosphorous cycle).

Phosphorus Cycle



Phosphorus Cycle

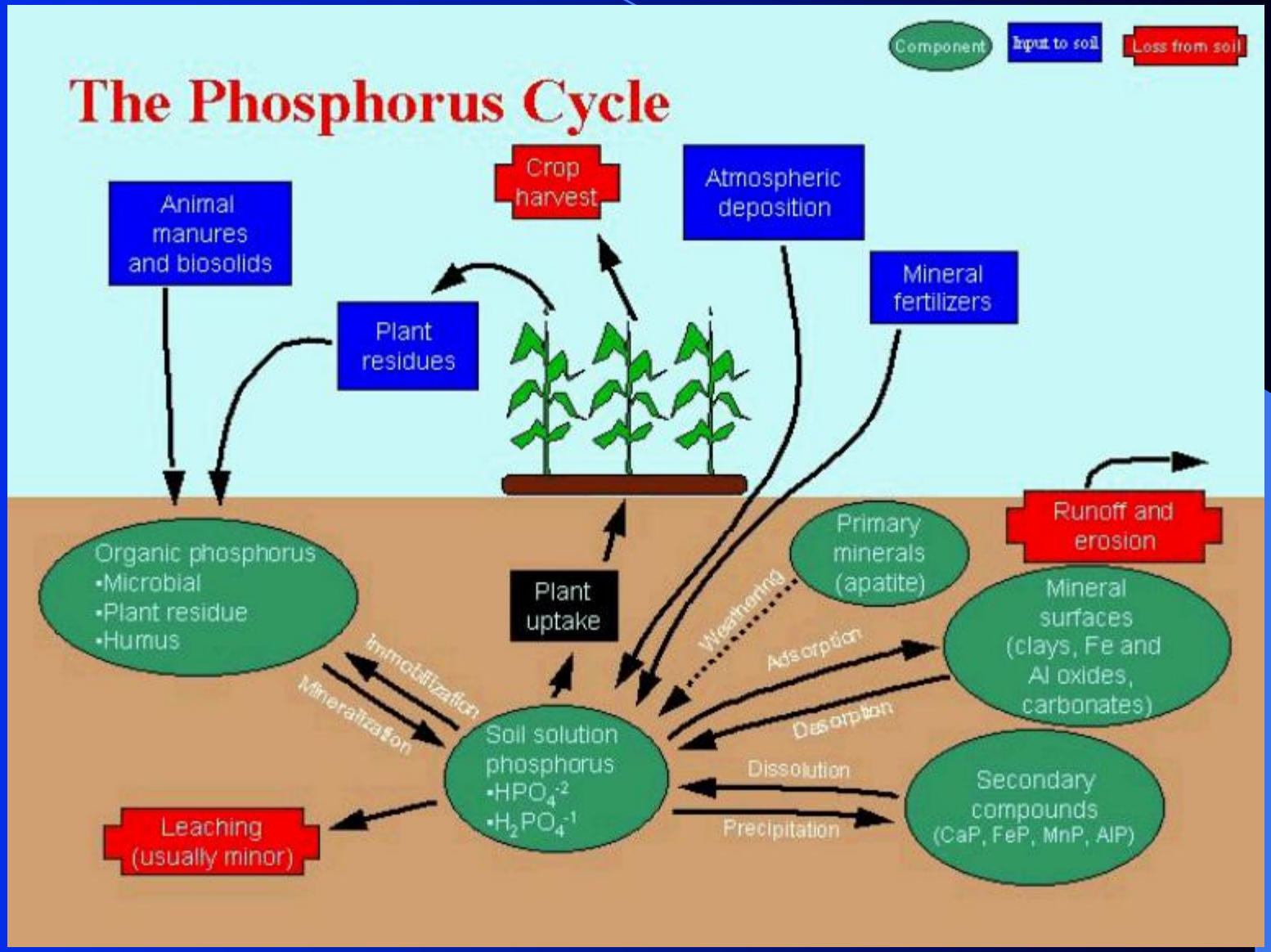
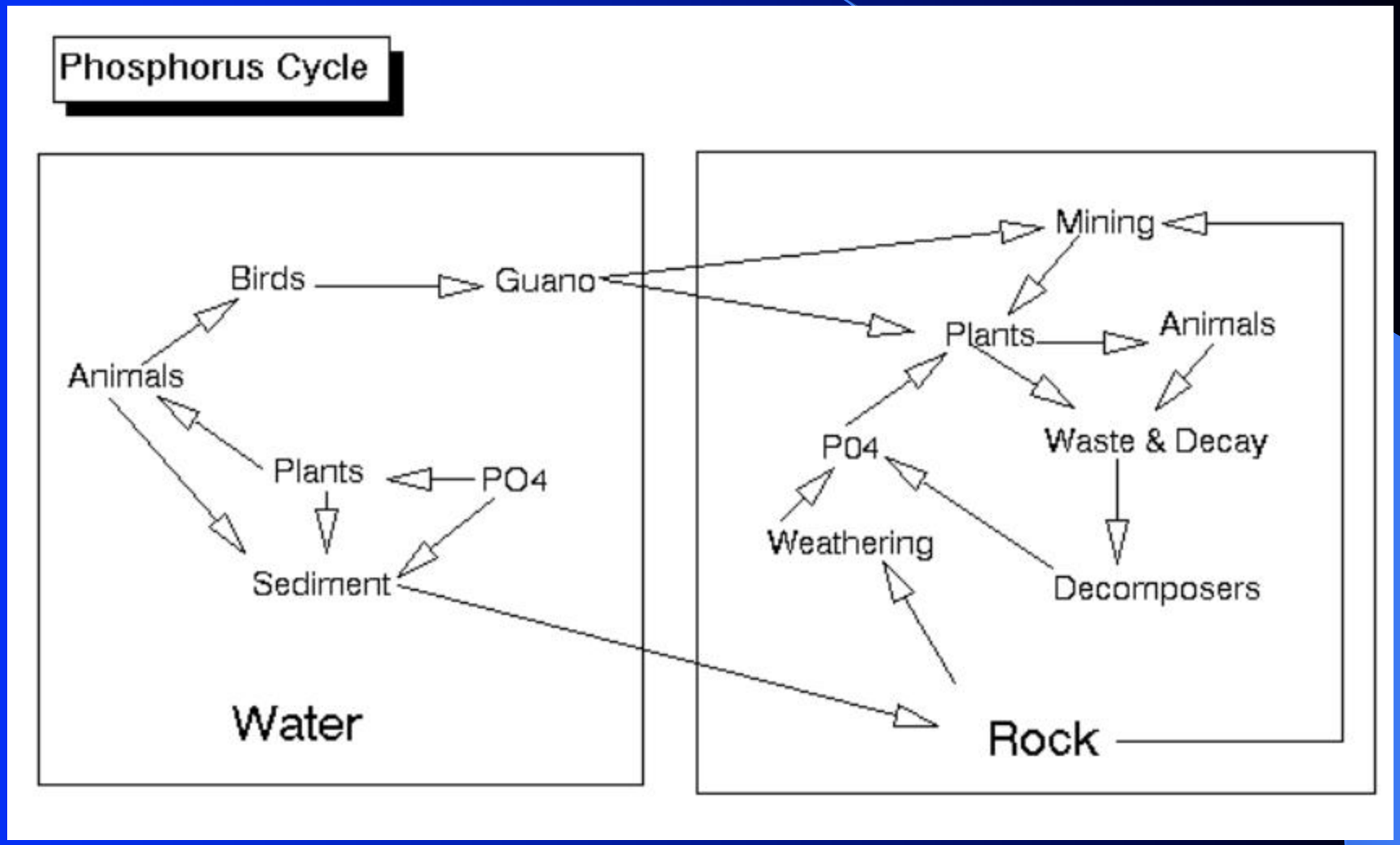
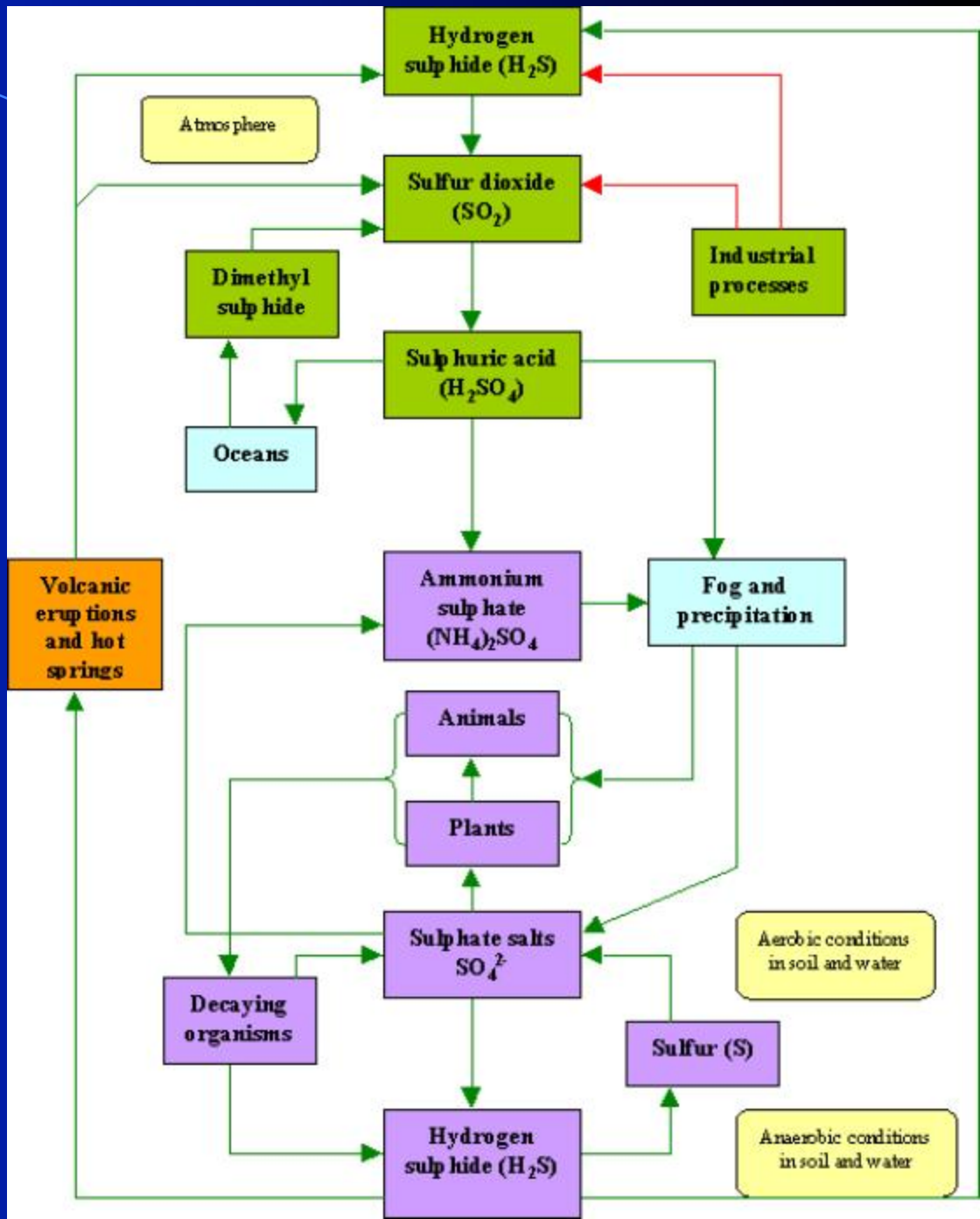


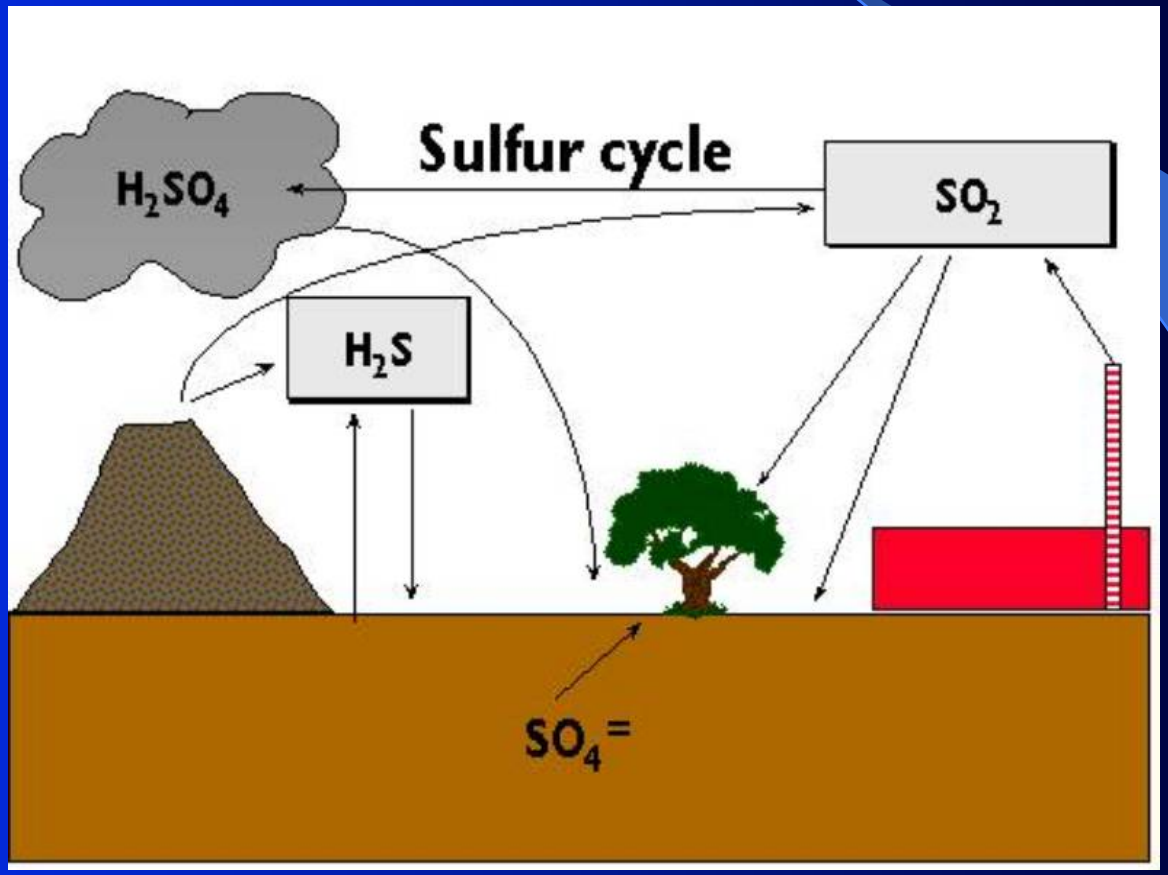
Diagram of Phosphorus Cycle



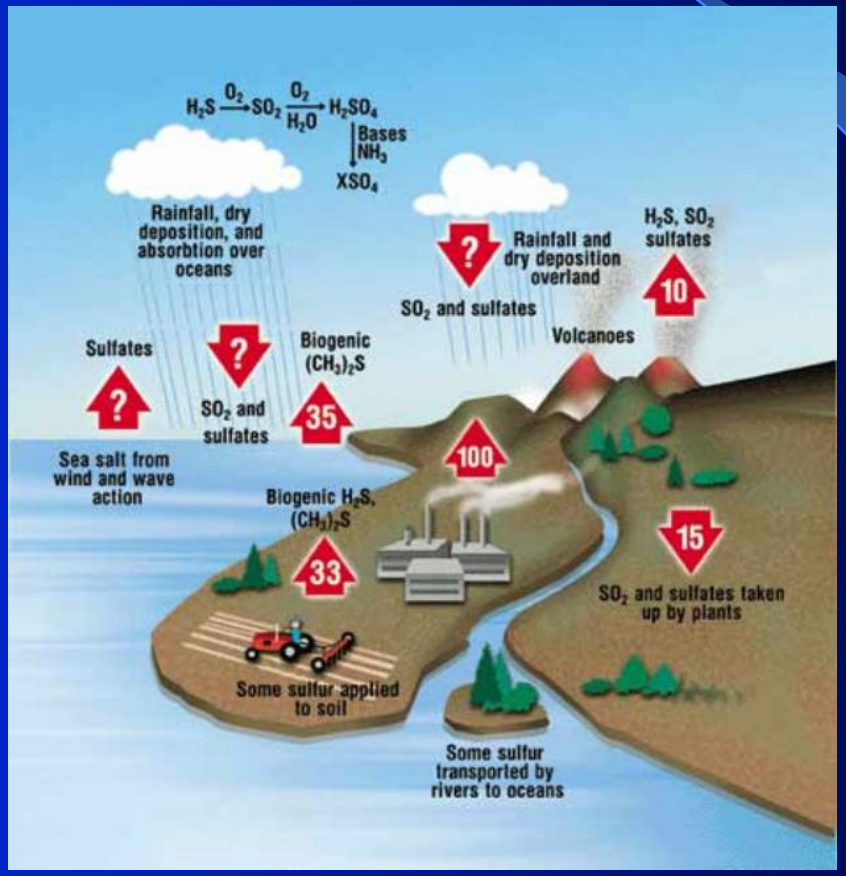
Sulphur Cycle

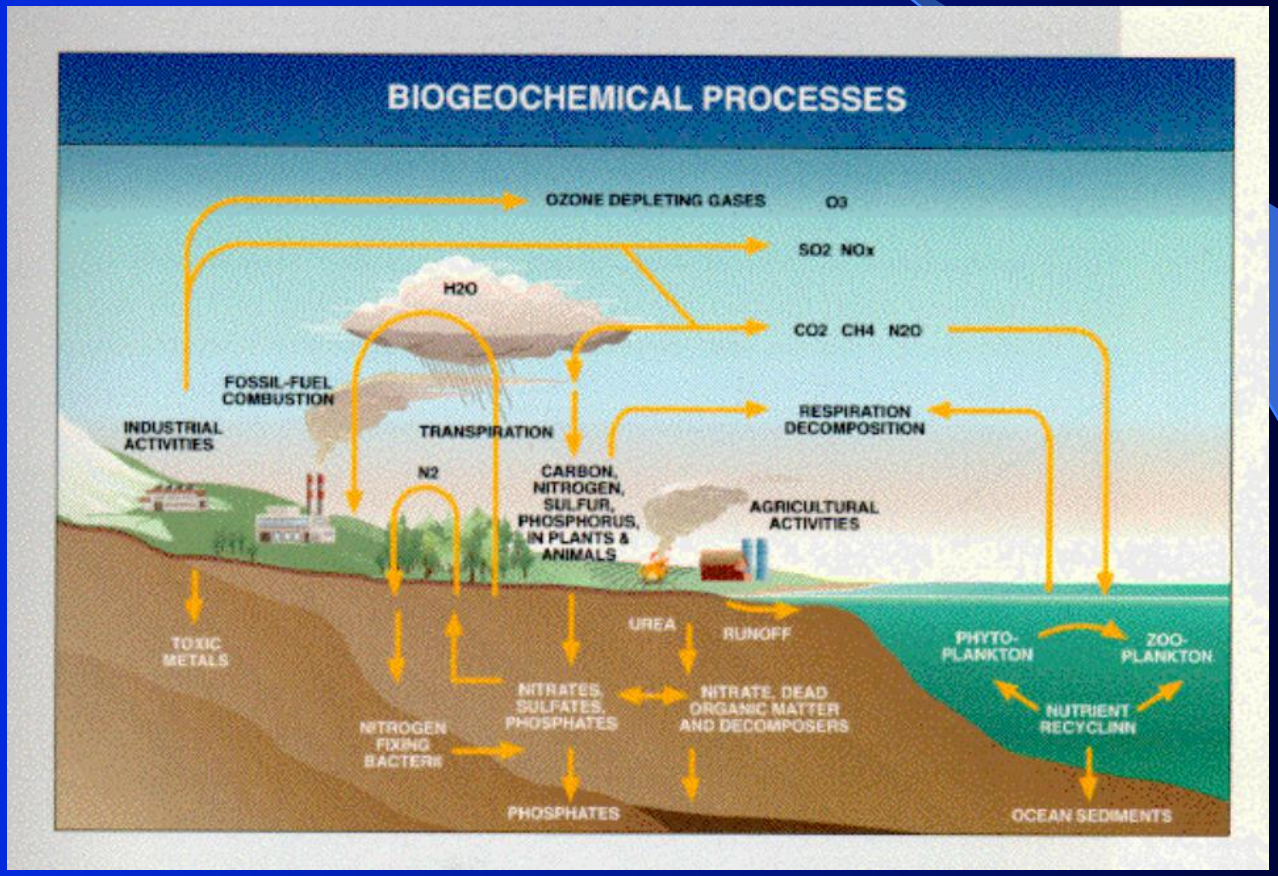


Sulphur Cycle



Sulphur Cycle




BIOGEOCHEMICAL PROCESSES
OZONE DEPLETING GASES
O3
SO2 NOx
H2O
CO2 CH4 N2O
FOSSIL-FUEL COMBUSTION
INDUSTRIAL ACTIVITIES
TRANSPIRATION
RESPIRATION DECOMPOSITION
N2
CARBON, NITROGEN, SULFUR, PHOSPHORUS, IN PLANTS & ANIMALS
AGRICULTURAL ACTIVITIES
TOXIC METALS
UREA
RUNOFF
PHYTO-PLANKTON
ZOO-PLANKTON
NITRATES, SULFATES, PHOSPHATES
NITRATE, DEAD ORGANIC MATTER AND DECOMPOSERS
NITROGEN FIXING BACTERII
NUTRIENT RECYCLINN
PHOSPHATES
OCEAN SEDIMENTS

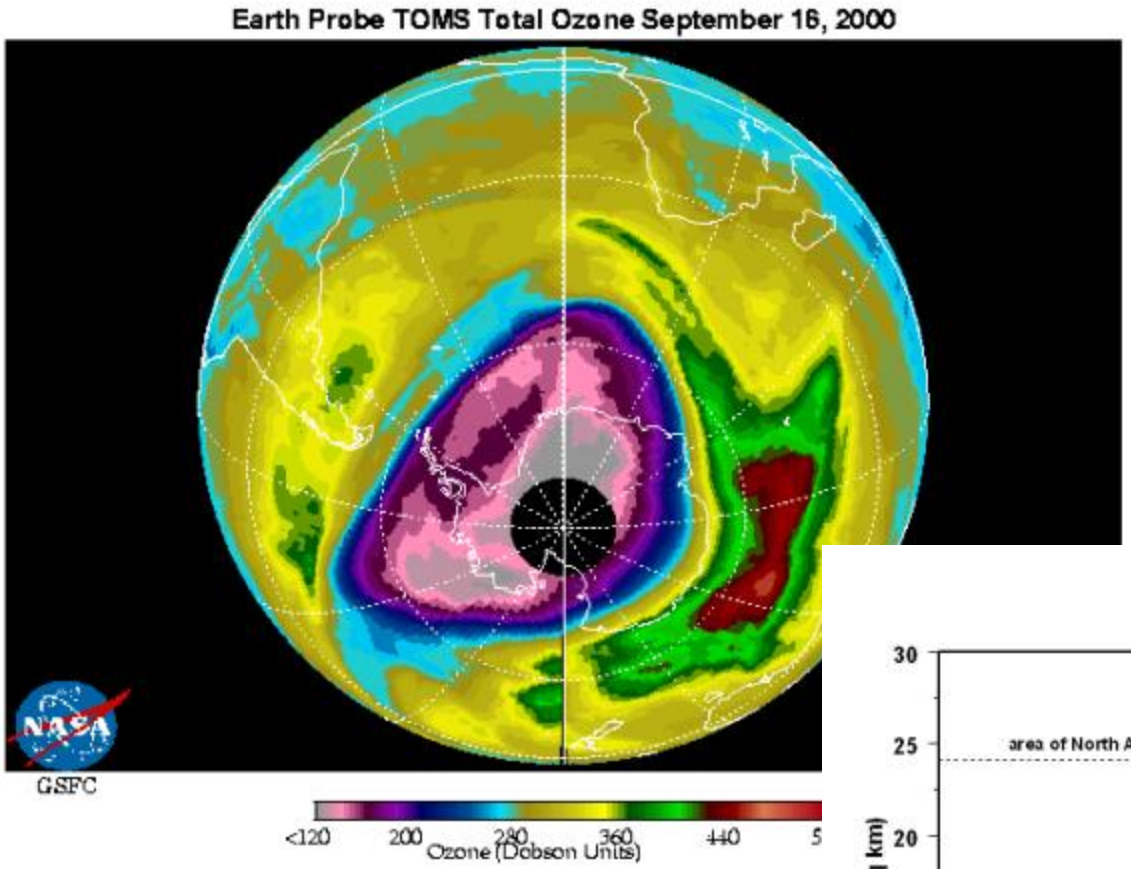
Conclusions

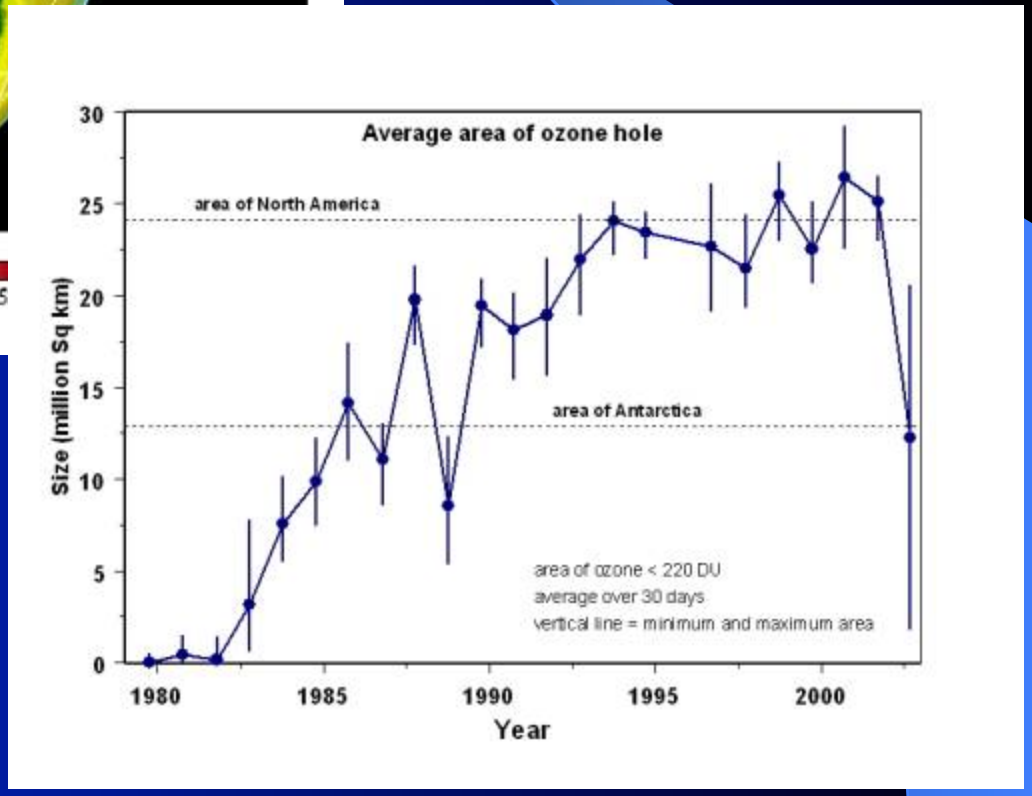
In contrast to energy, which moves in one direction through the ecosystem, materials are continually recycled from the abiotic environment to organisms biotic, and back to the abiotic environment.

Changes in one of the biogeochemical cycles usually influences the other biogeochemical cycles.

Climate in more detail

Ozone Hole over Antarctica





Ban on fluorocarbons began 1979

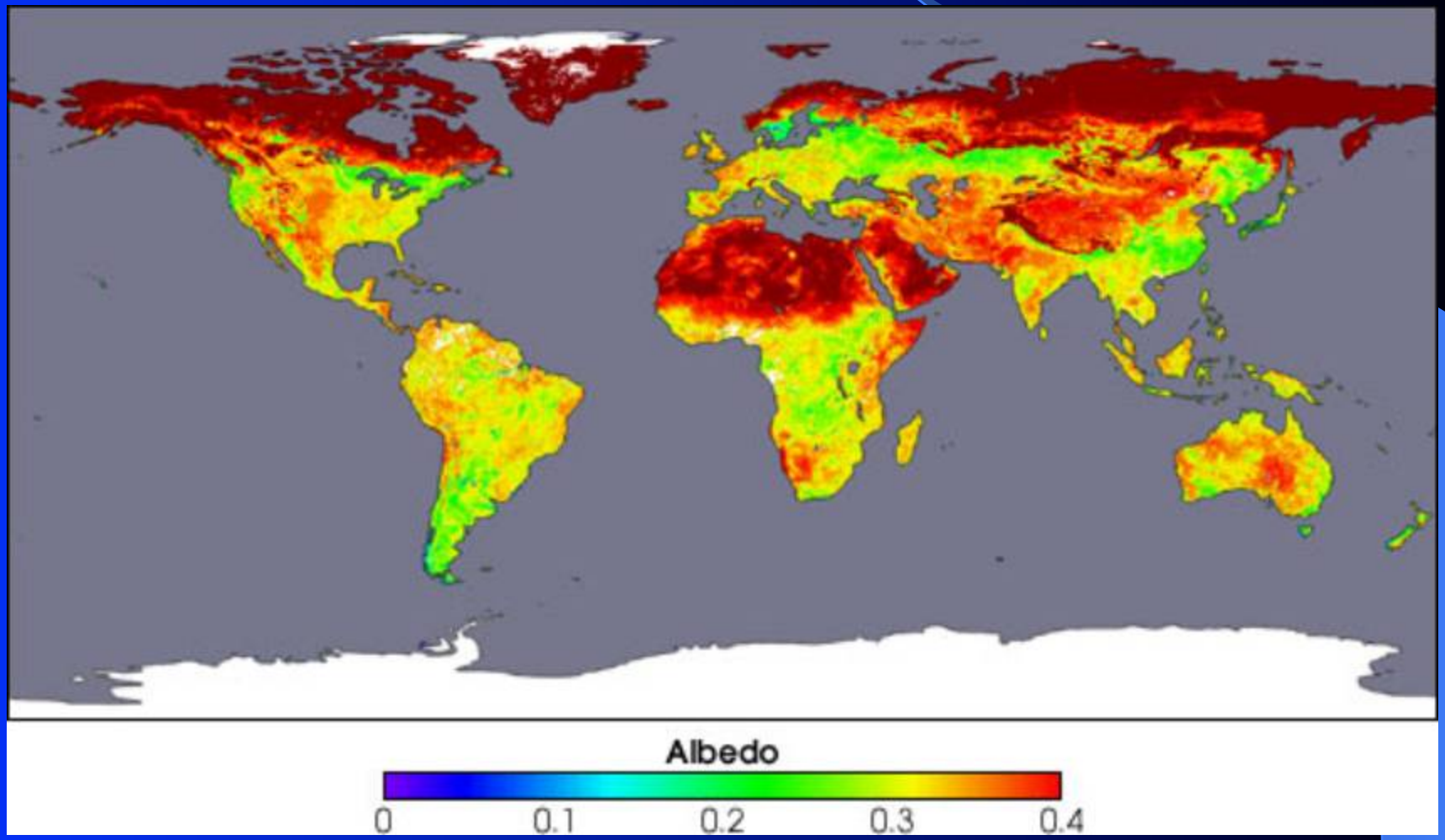
Solar Radiation
Albedo (Surface Reflectivity)

Albedo refers to ratio of the amount of reflected light to incident light. The higher the number the greater the proportion of light is reflected back.

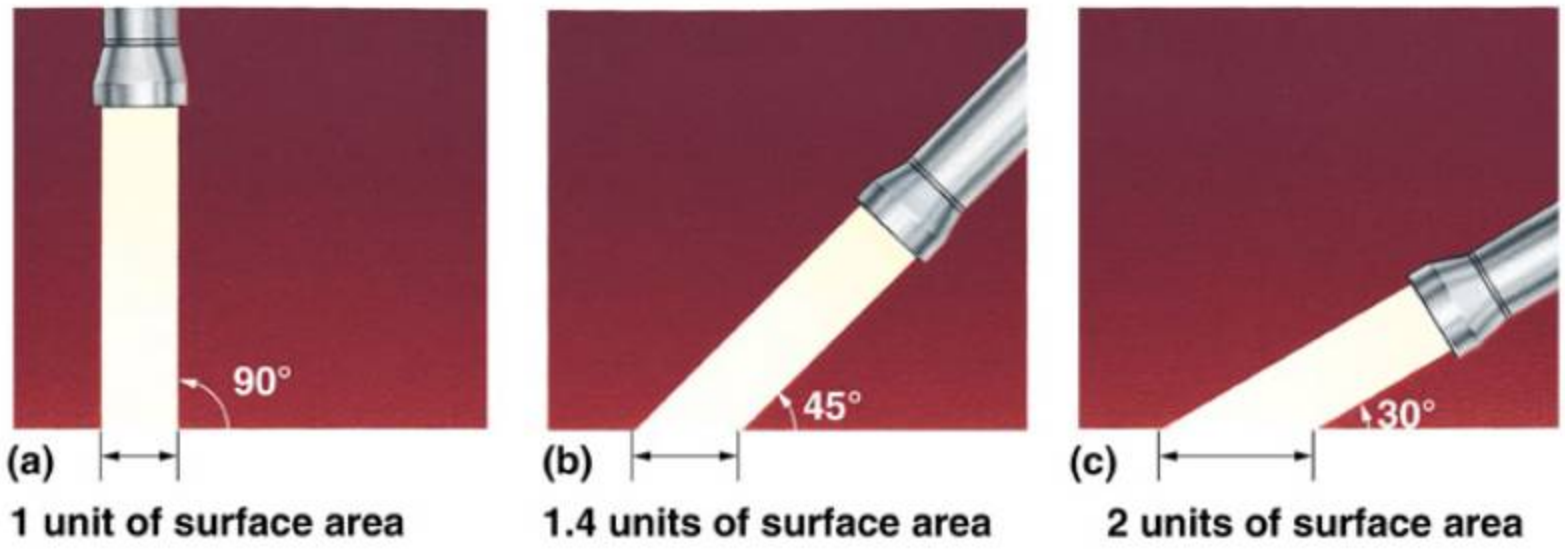
Glaciers and ice packs have an albedo of 0.8-0.9 (80-90%), while oceans and forests have an albedo of around 0.05 (5%).

On average, 30% of solar radiation is immediately reflected back into space.

Global Map of Land Albedo



Solar Radiation
Temperature Change with Latitude



Conclusion: the greater the angle light strikes the earth, the greater amount of area over which each unit of energy is spread.

Solar Radiation

Occurs in a range of wavelengths represented by the electromagnetic spectrum.

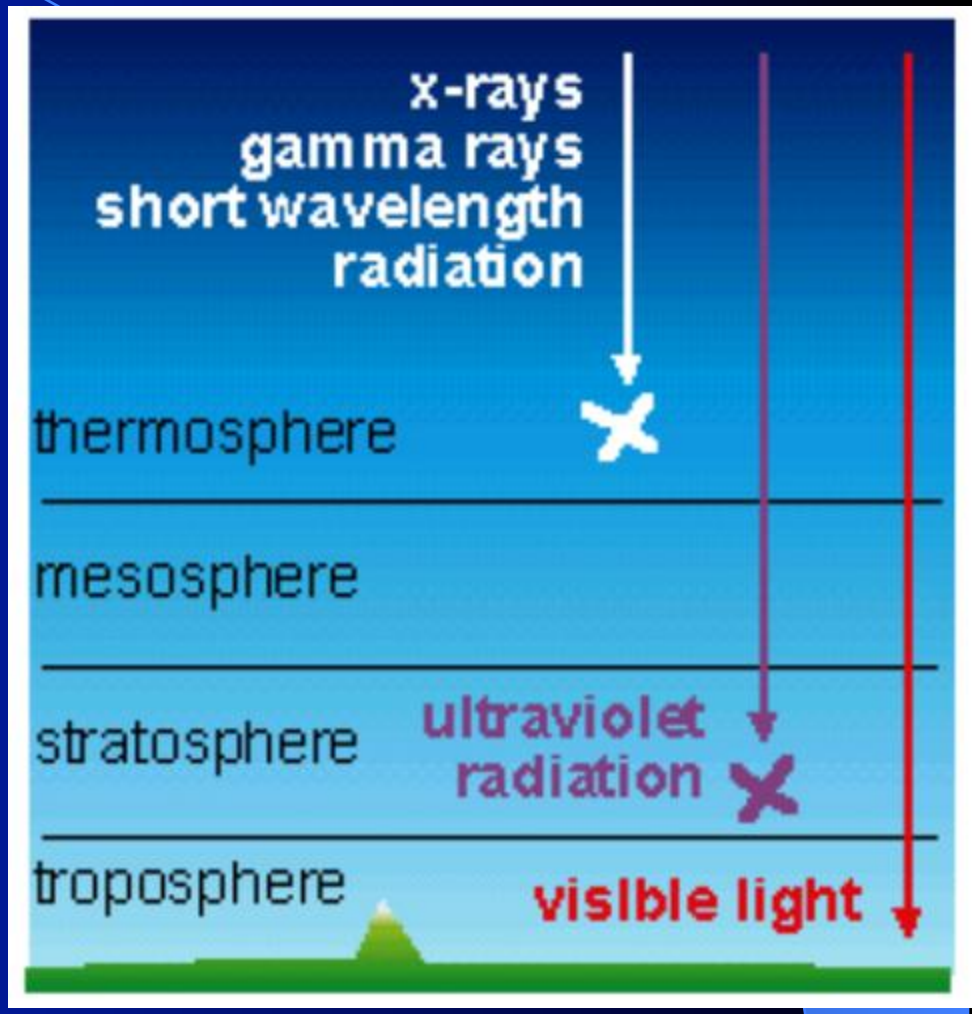
Reaches Earth's atmosphere in the form of ultraviolet radiation, visible light, and infrared radiation.

Incoming short and intermediate wavelength radiation may be: absorbed by gases in the atmosphere, reflected back into space from the atmosphere or earth's surface, or absorbed by the earth's surface.

Solar Radiation

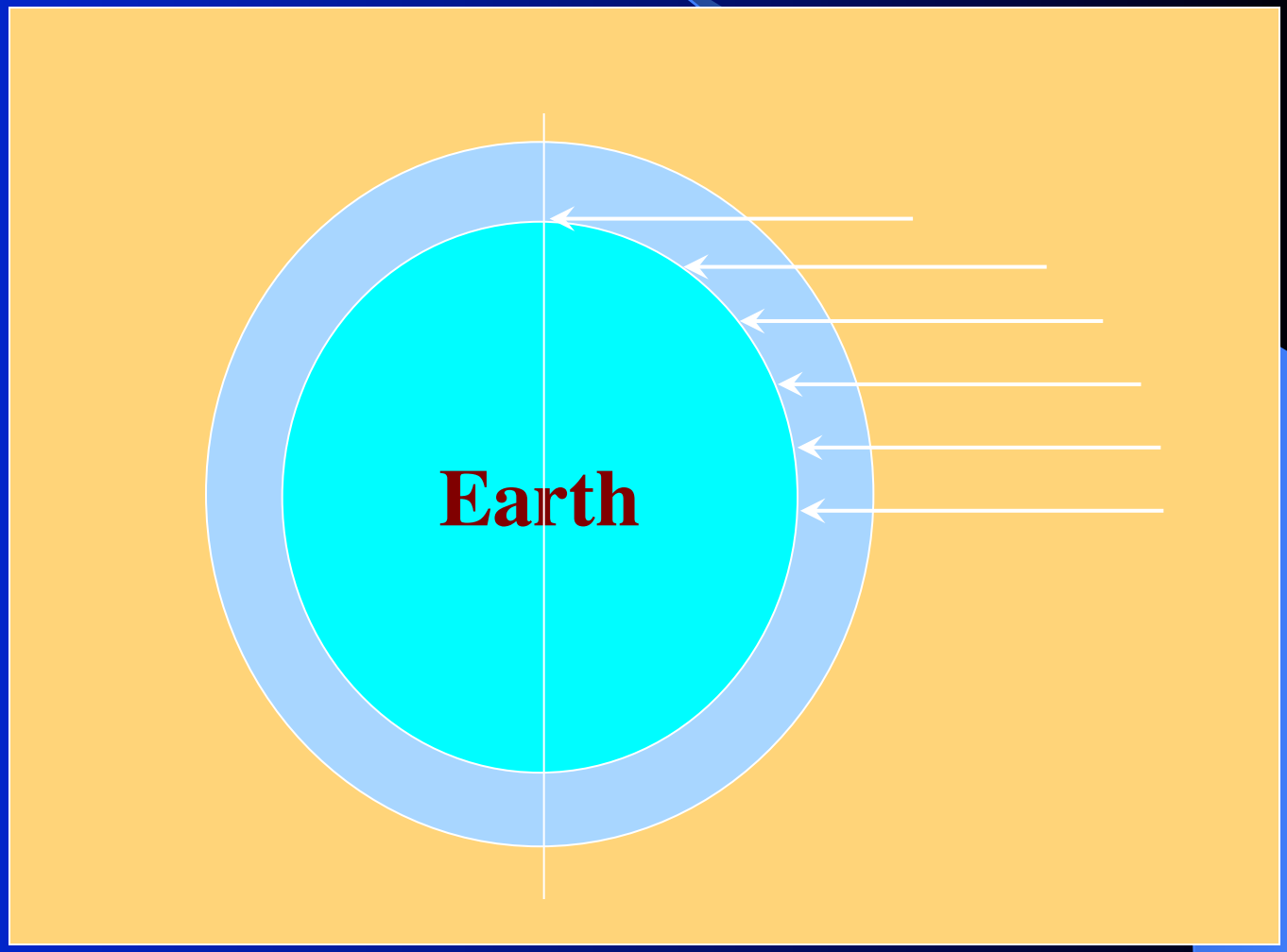
Incoming <u>and</u> outgoing long wavelength radiation is absorbed by water vapor, carbon dioxide, and other gases in the atmosphere.

The greenhouse effect occurs when long wavelength radiation is absorbed in the troposphere

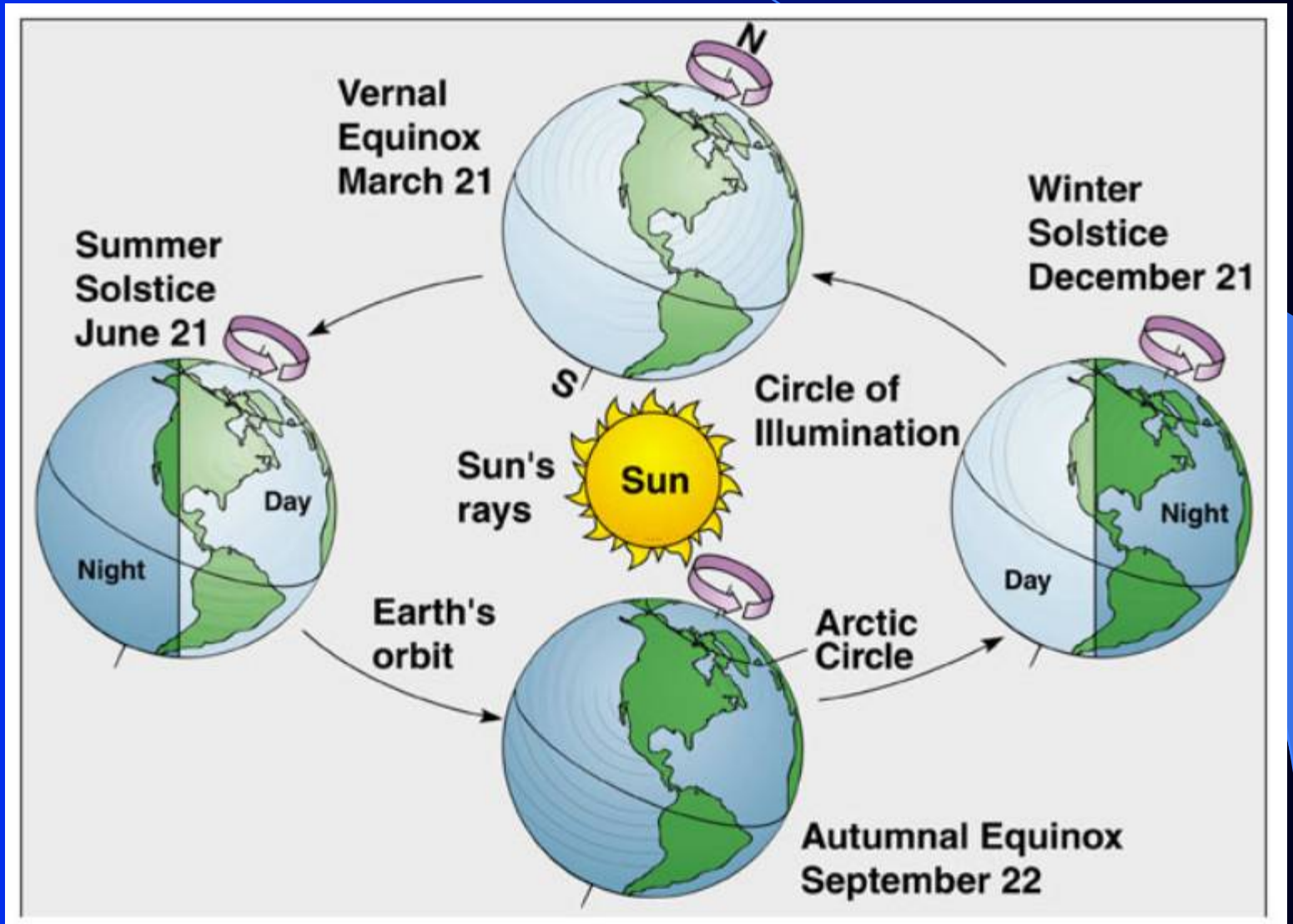


Solar Patterns are the Basis of Climate

The distance through atmosphere is different at high versus low latitudes.



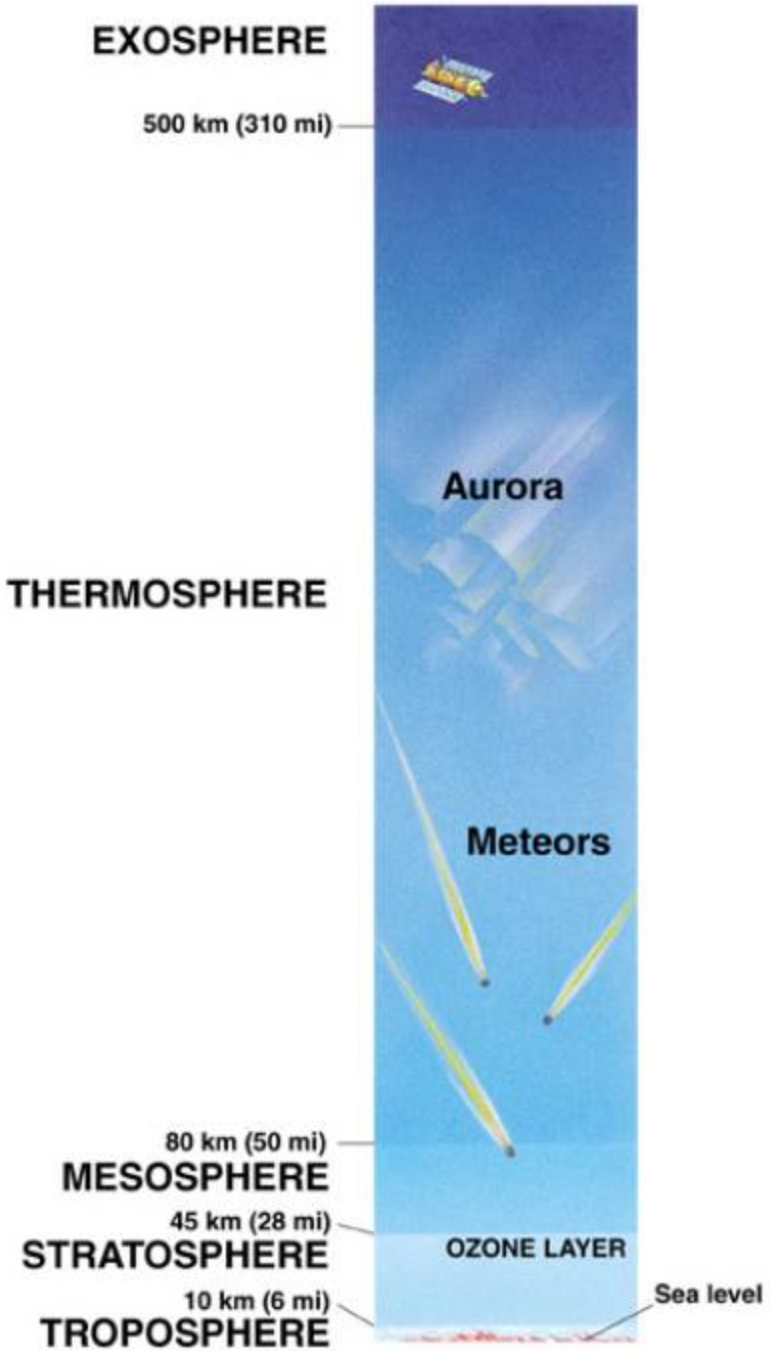
The Earth at 23.5^{O} Tilt Seasonal Variation.



Atmosphere

Distinct zones of contrasting temperatur and compositions.

Thermosphere - high temperature (includes ionosphere - auroras)..
Mesosphere - low temperatures.
Stratosphere - high levels of Ozone. Absorbs ultraviolet ray
Troposphere - nitroge and oxygen; weather.



Structure of Atmosphere

The atmosphere can be divided into four thermal layers: troposphere, stratosphere, mesosphere, and thermosphere.

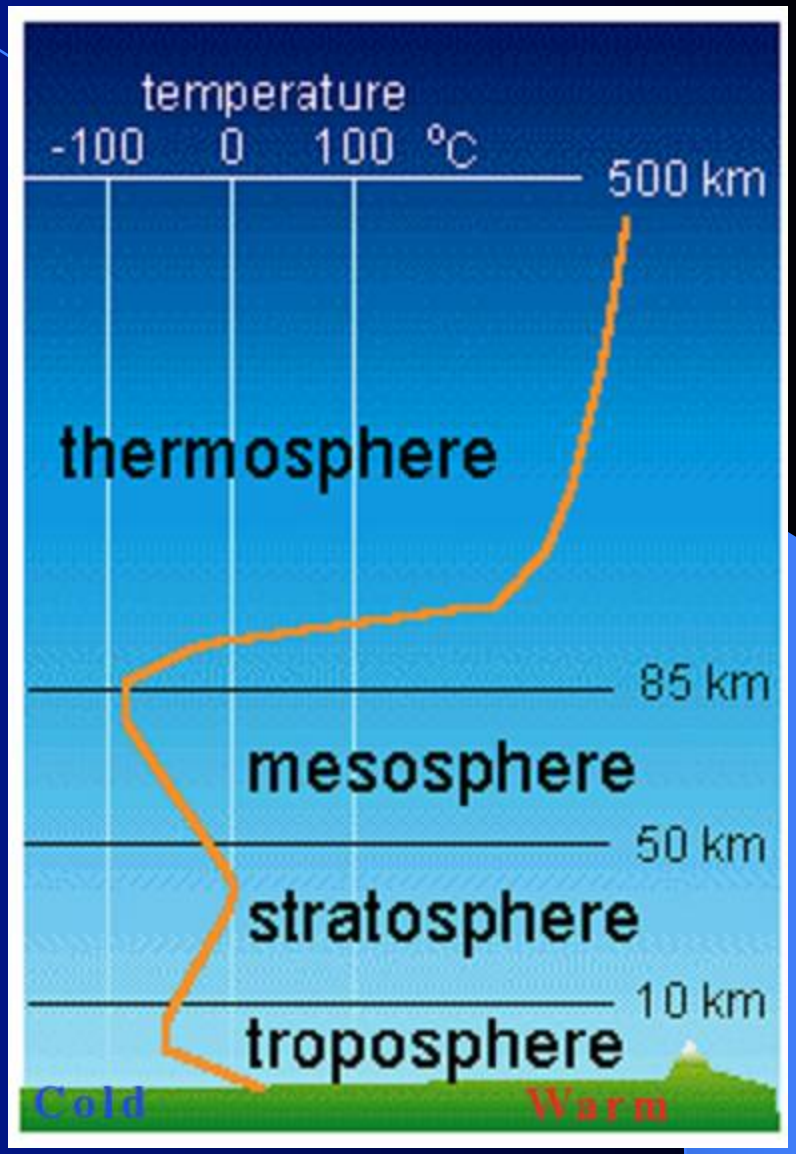
The boundary with space is at an altitude of approximately 500 km.

Air temperatures decrease upward in the troposphere (to a minimum of approximately -50°C) which contains our weather systems. Bulk of atmospheric gases (~75%) in this layer.

Structure of Atmosphere

Temperatures increase with altitude in the stratosphere as ozone absorbs incoming solar radiation.

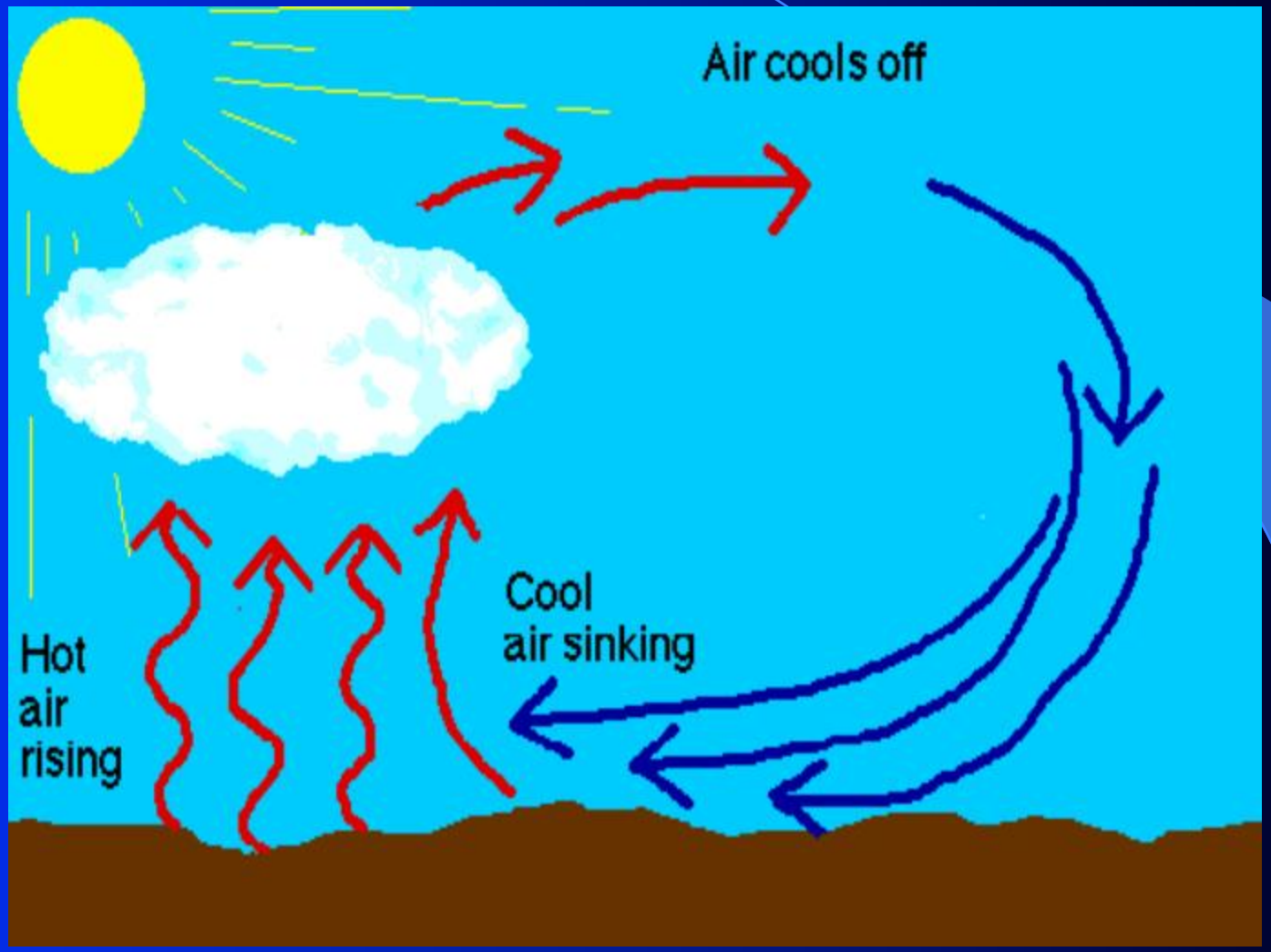
Temperatures decline again in the mesosphere but increase in the thermosphere.

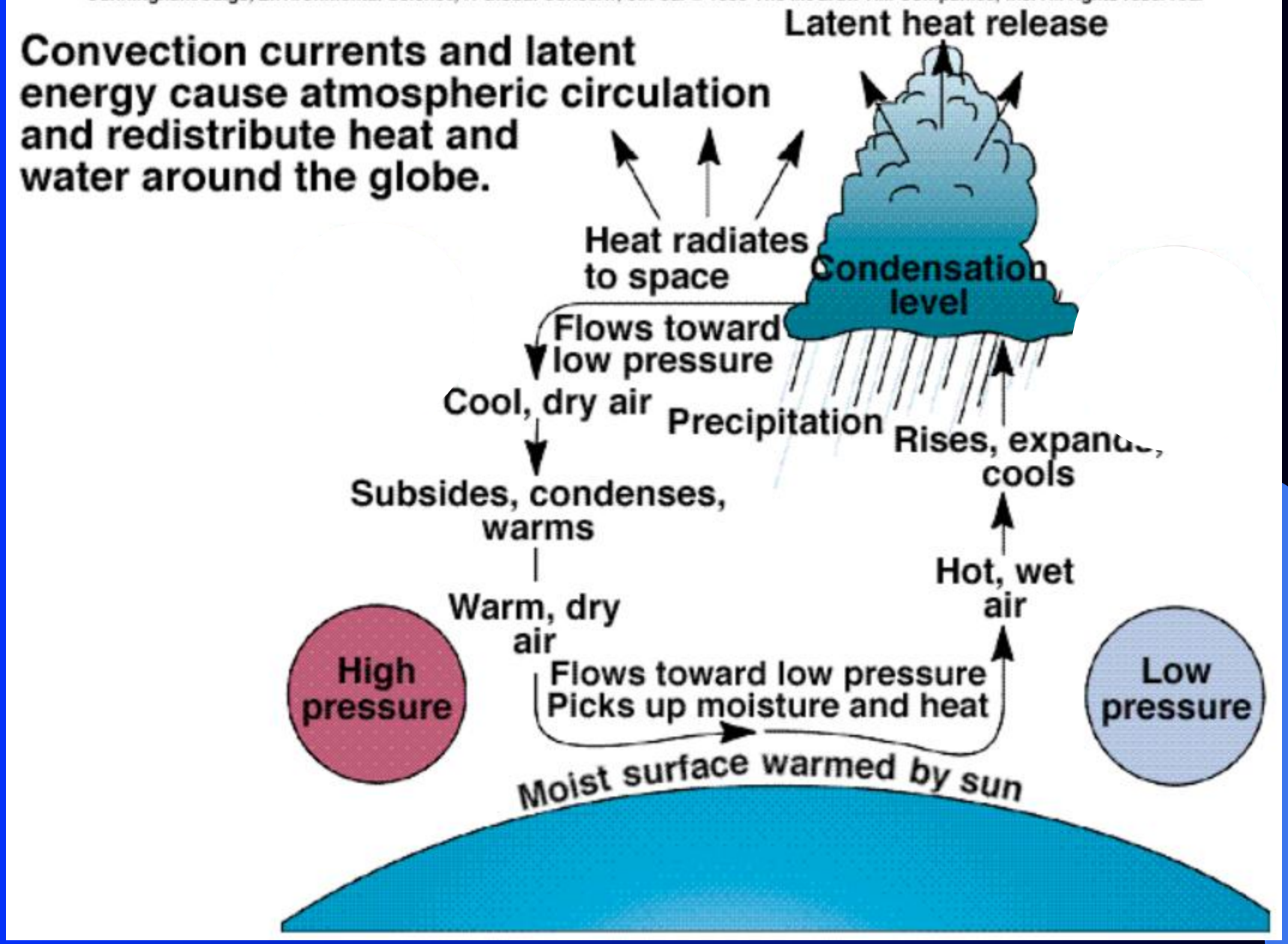


What are we breathing?

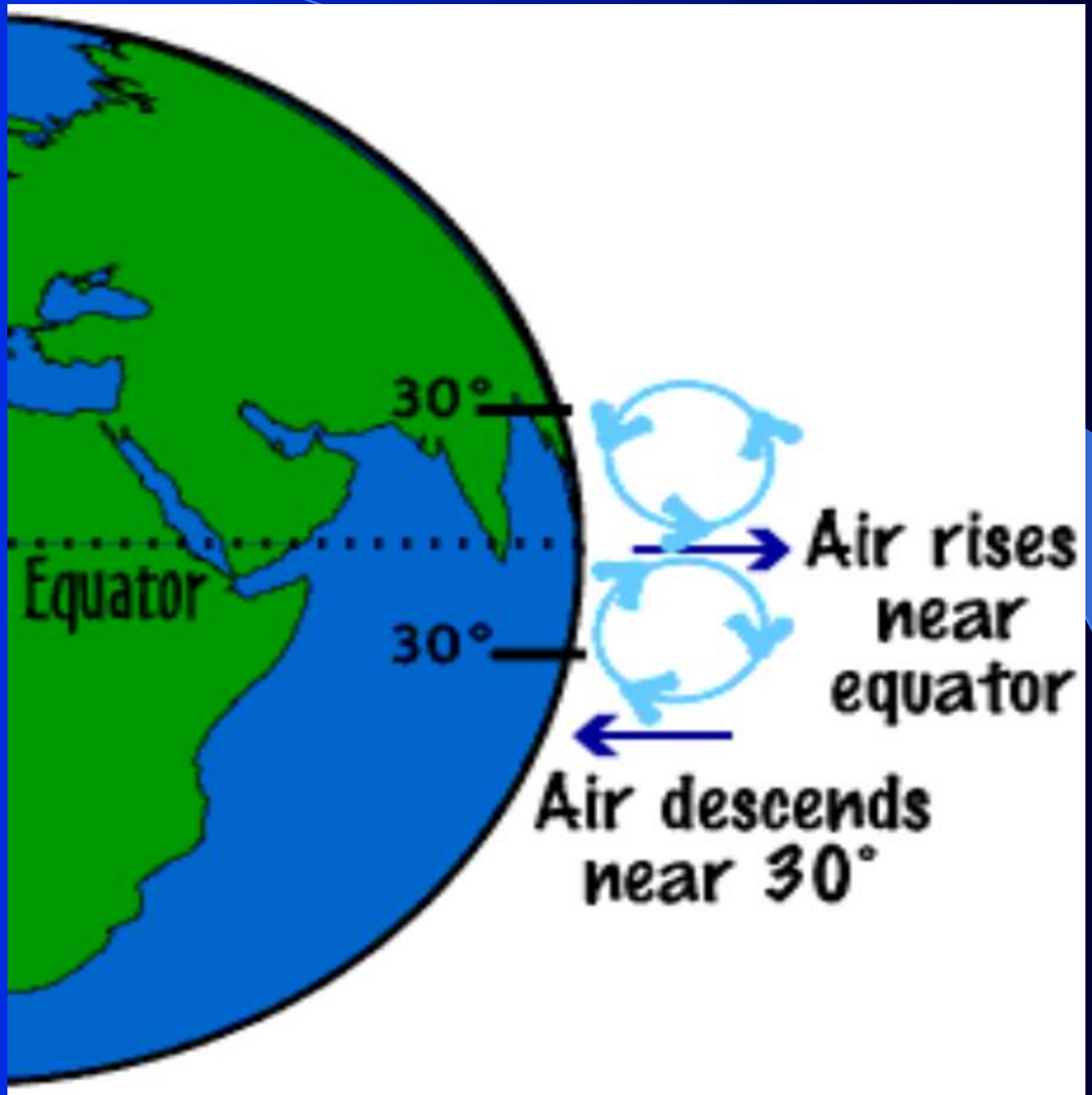
Present composition of the lower atmosphere		
Gas	**Symbol or Formula**	**Percent by Volume**
Nitrogen	N_2	78.08
Oxygen	O_2	20.94
Argon	Ar	0.934
Carbon dioxide	CO_2	0.035
Neon	Ne	0.00182
Helium	He	0.00052
Methane	CH_4	0.00015
Krypton	Kr	0.00011
Hydrogen	H_2	0.00005
Nitrous oxide	N_2O	0.00005
Xenon	Xe	0.000009

Air Mass Formation



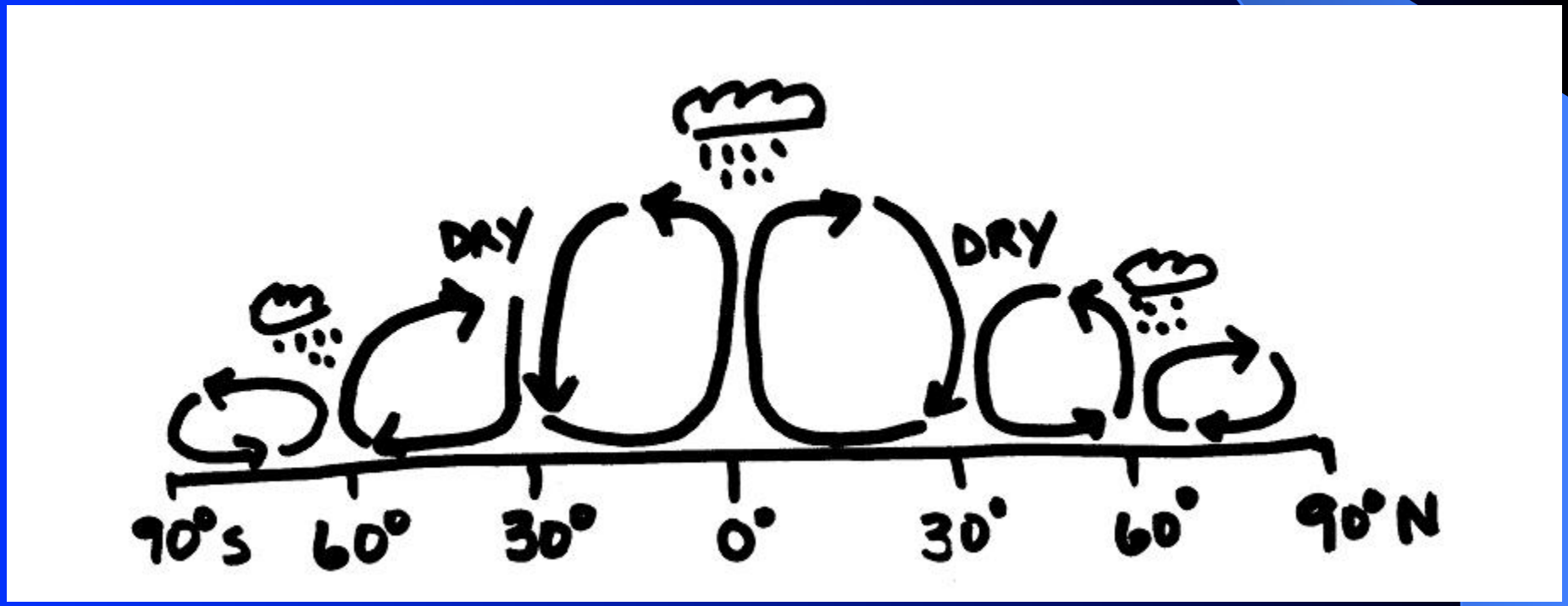


General Air Patterns

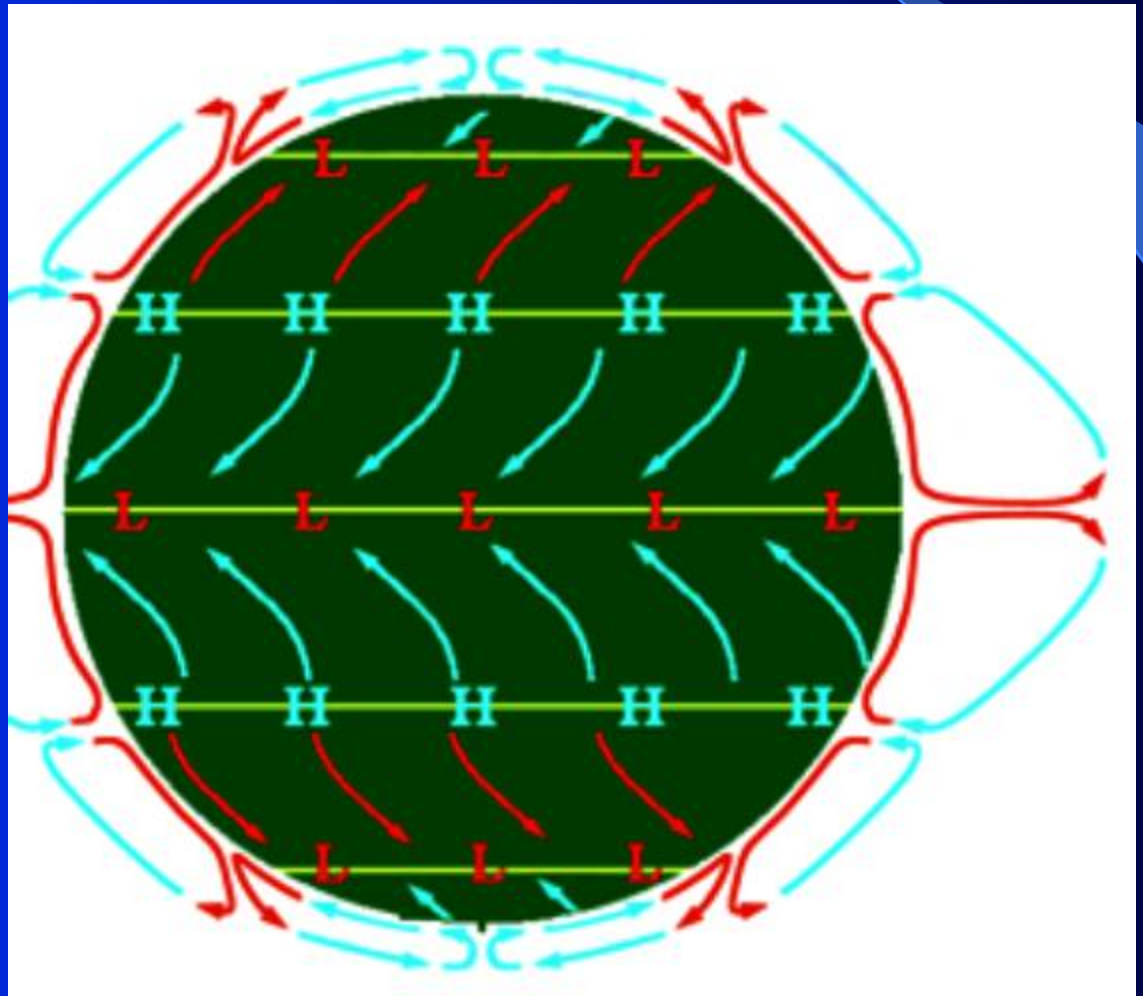


Atmospheric Circulation Pattern

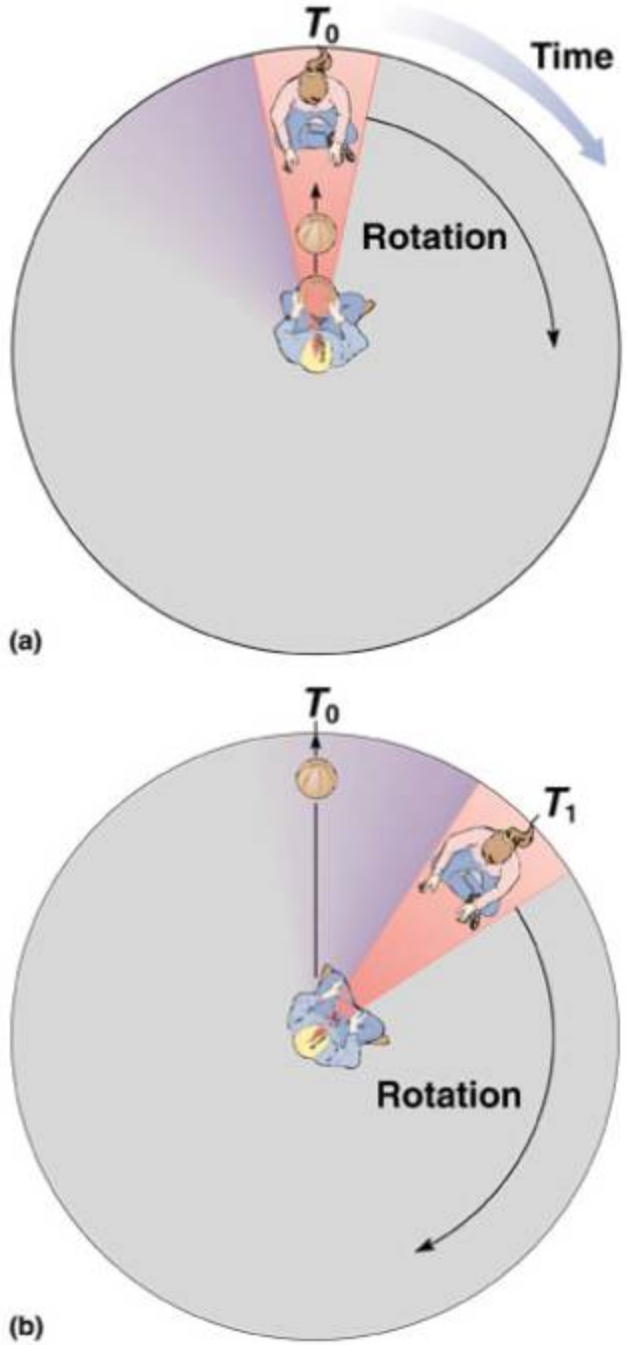
The sun, through heating of land and air, drives the earth's patterns of rains, winds, and ocean currents.



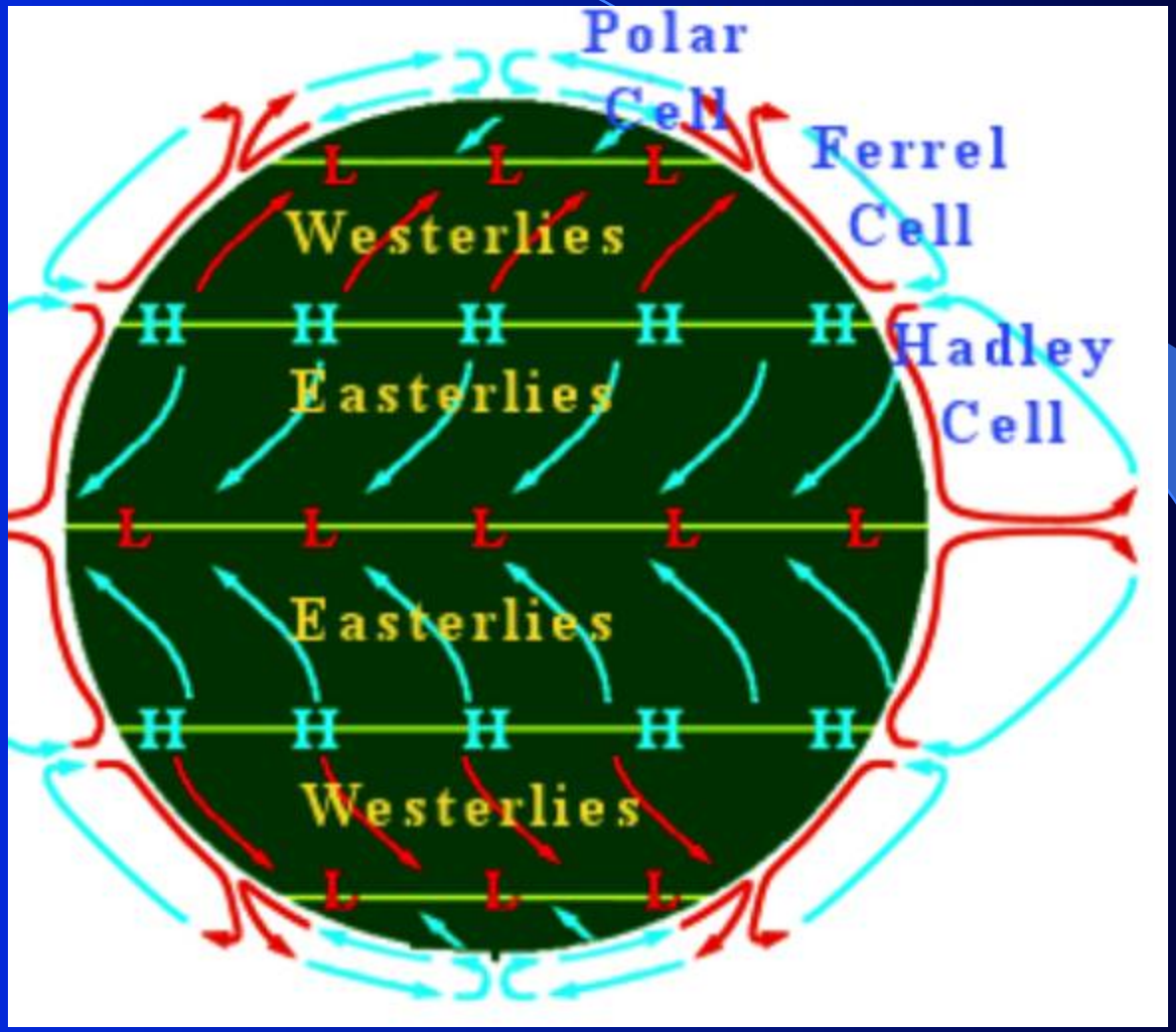
Air on the move



Coriolis Effect



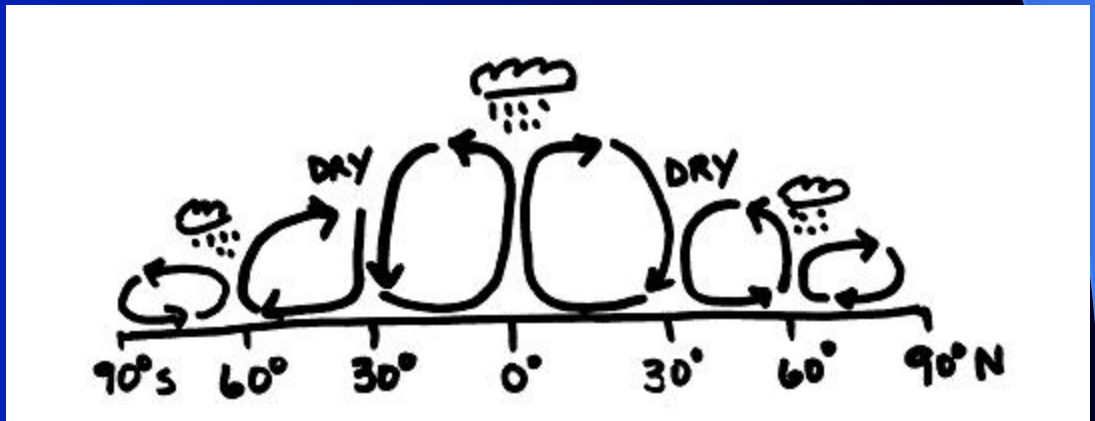
Cell Names…



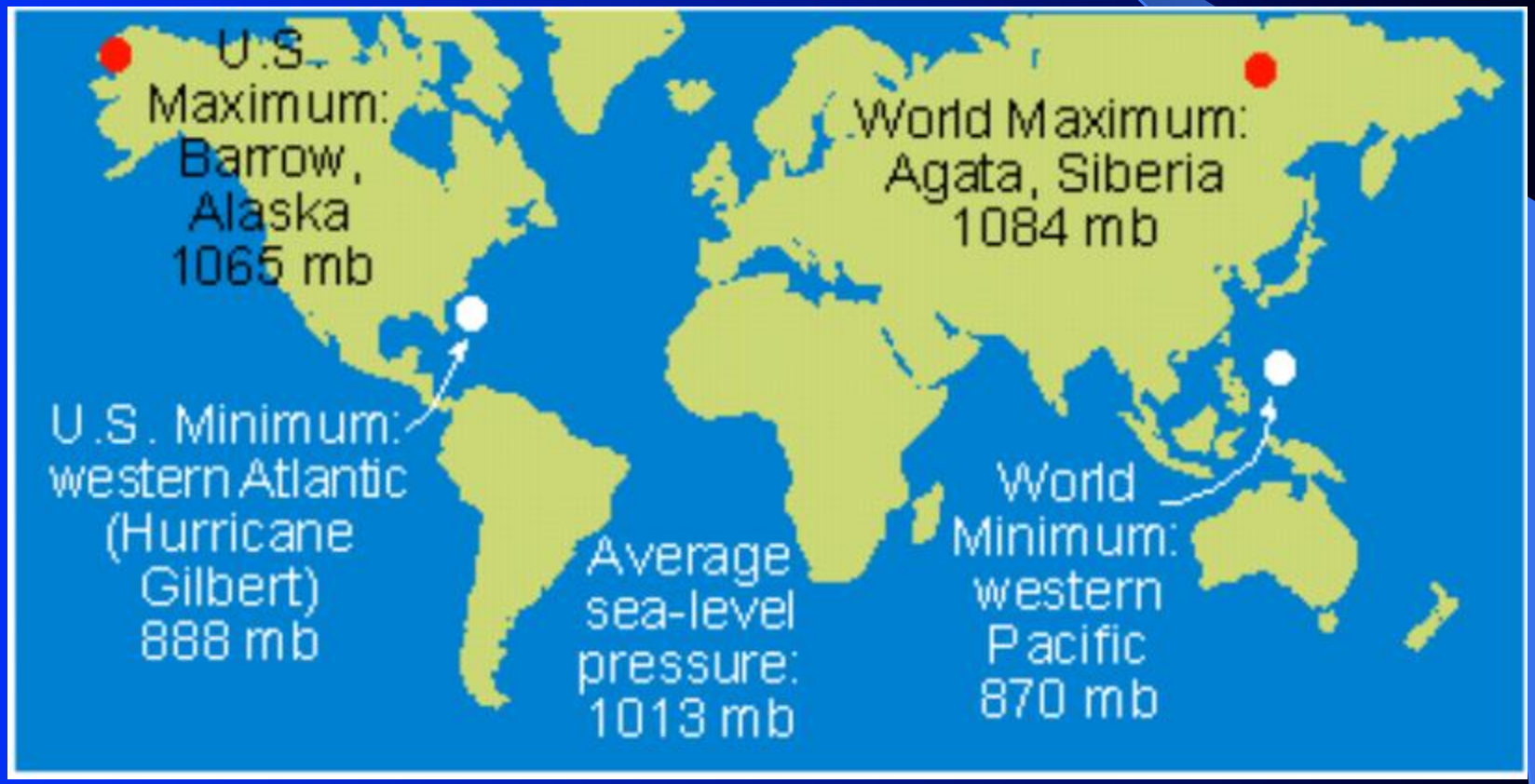
http://goes-rap.cira.colostate.edu/GOES-10/GEMS/Original/JPEG/Current/fulldisk_c01.jpg

Global Patterns of Air Circulation/ Precipitation

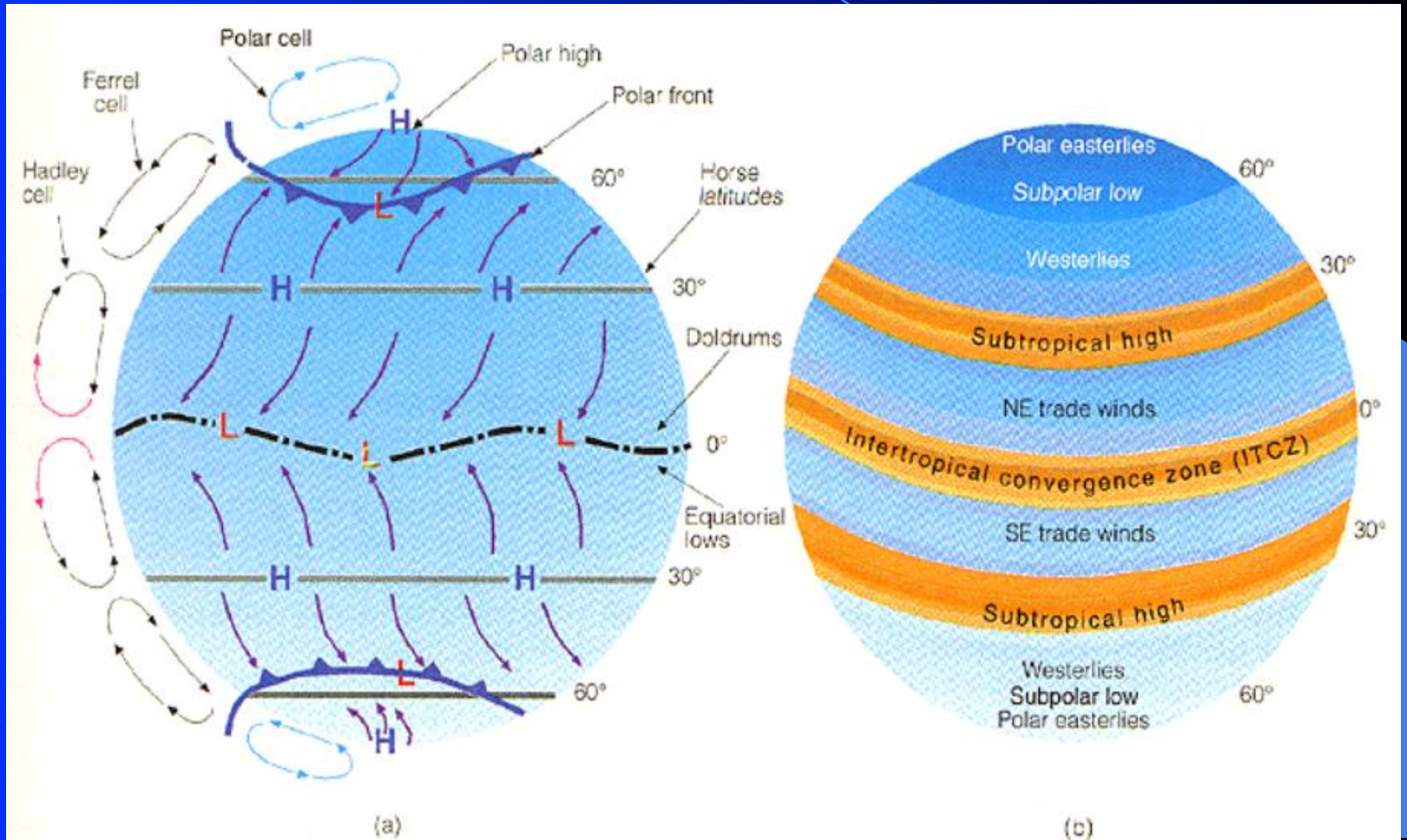
- Air rises at the equator (equator = hot) First convection cell is highest because most energy
- Adiabatic cooling
- Rain occurs (cool air holds less water).
- Air from the North and South comes in to replace it.
- **Coriolis effect** - air is deflected because of momentum.



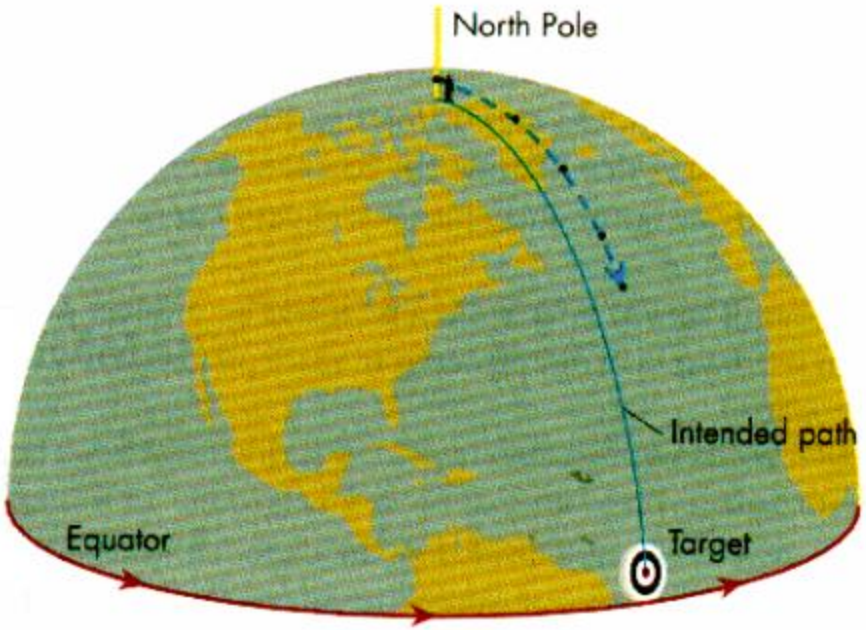
Air Pressures



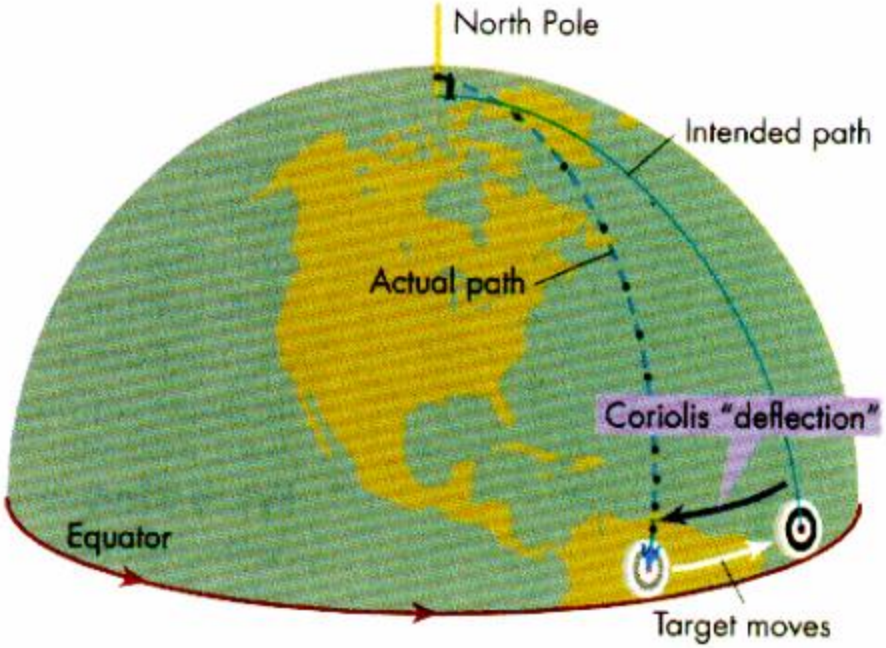
Areas of High and Low Pressure Generate Surface Winds



Coriolis Effect



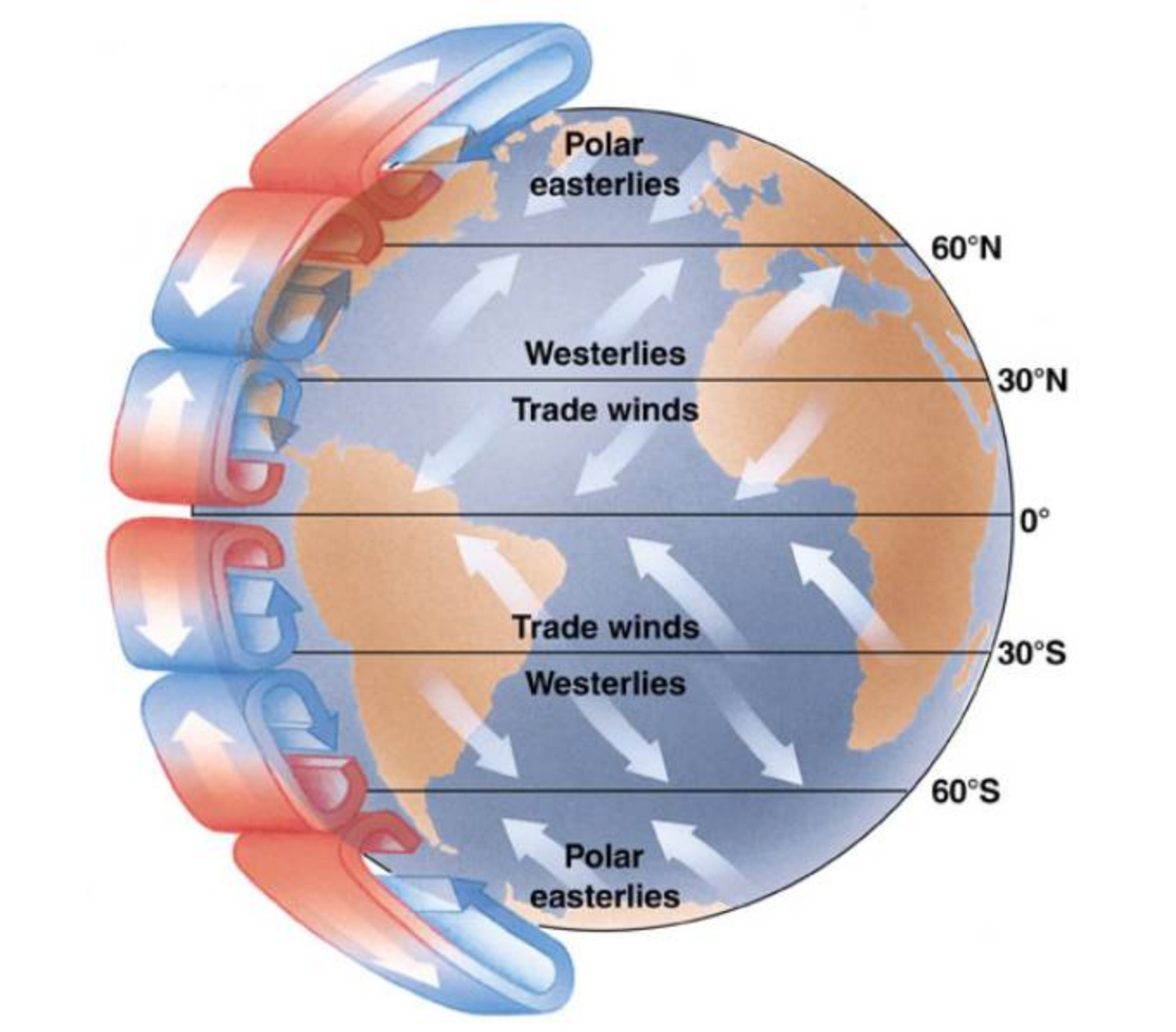
Rotating Earth



Rotating Earth

Coriolis Effect

Responsible for where wind blows from; wind patterns influence regional weather.



Winds

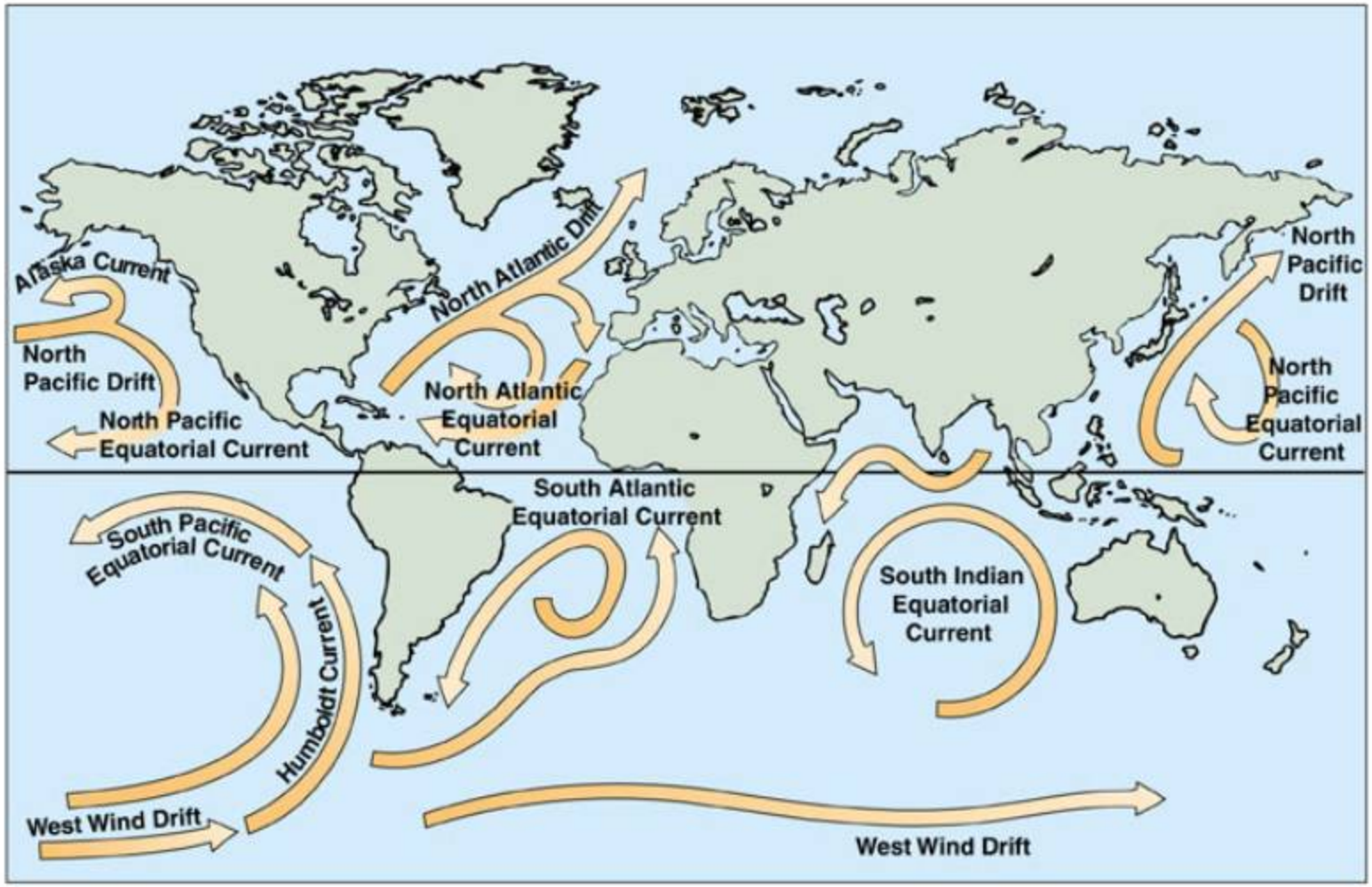
Wind is the horizontal movement of air from areas of high to low pressure.

High pressure regions are dominated by cold, descending air, while low pressure areas are associated with warm, rising air masses.

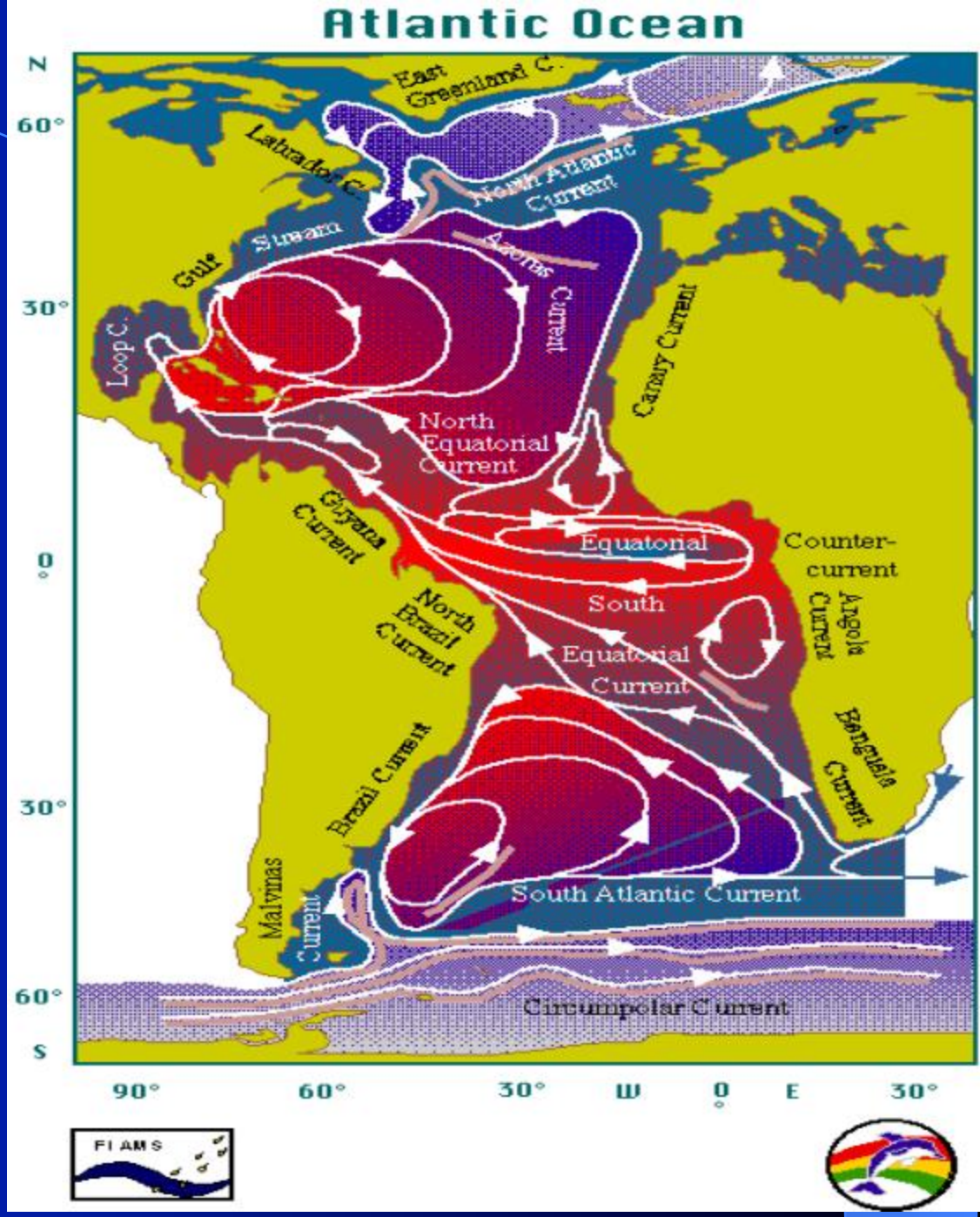
Winds blow from high pressure to low pressure.

Winds are deflected from their course by the Coriolis Effect (to the right in the Northern Hemisphere)

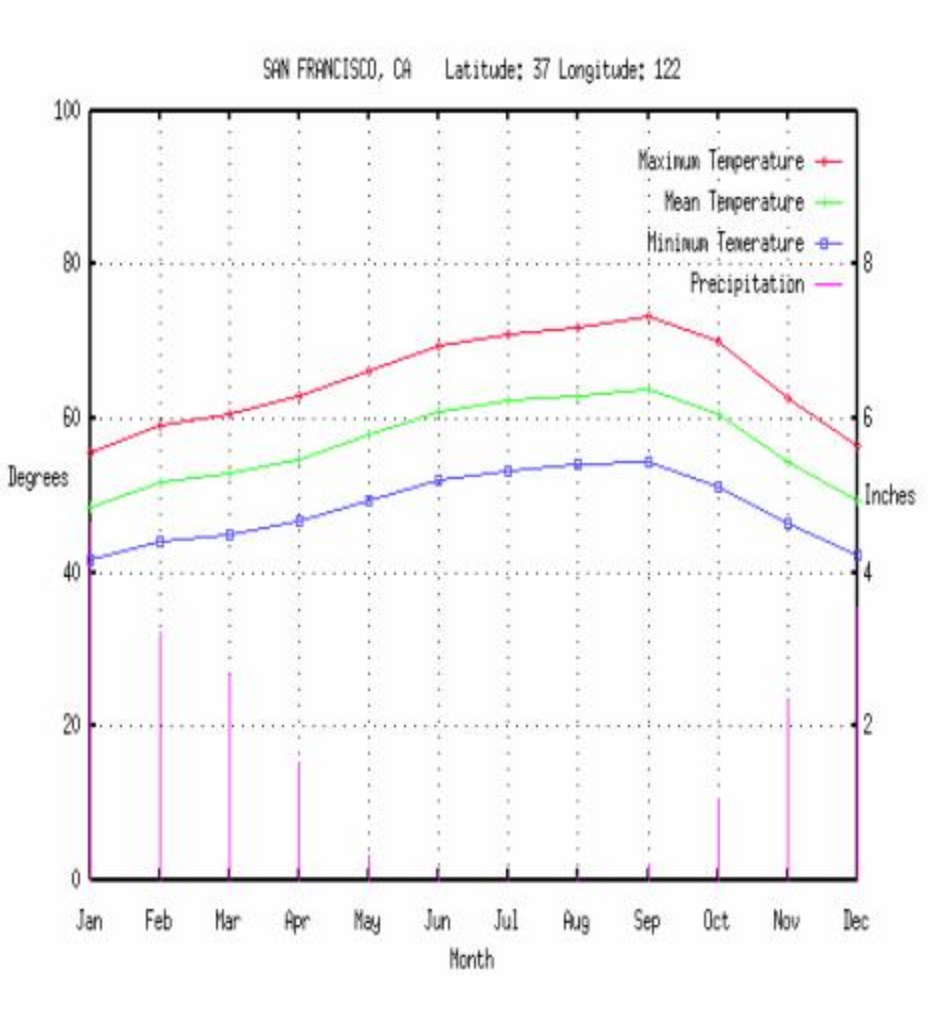
Ocean Currents Due to Coriolis Effect and Land Masses

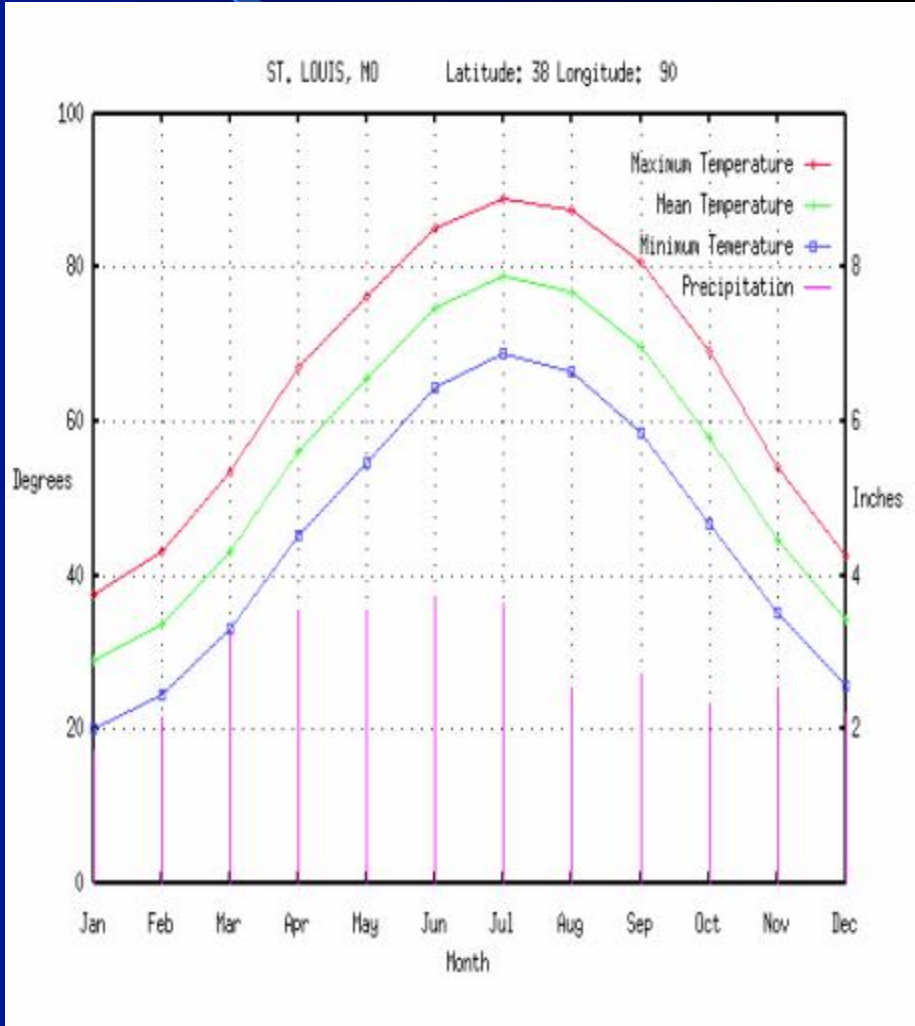


Ocean waters warmed in the equatorial regions transport heat energy to other parts of the globe.



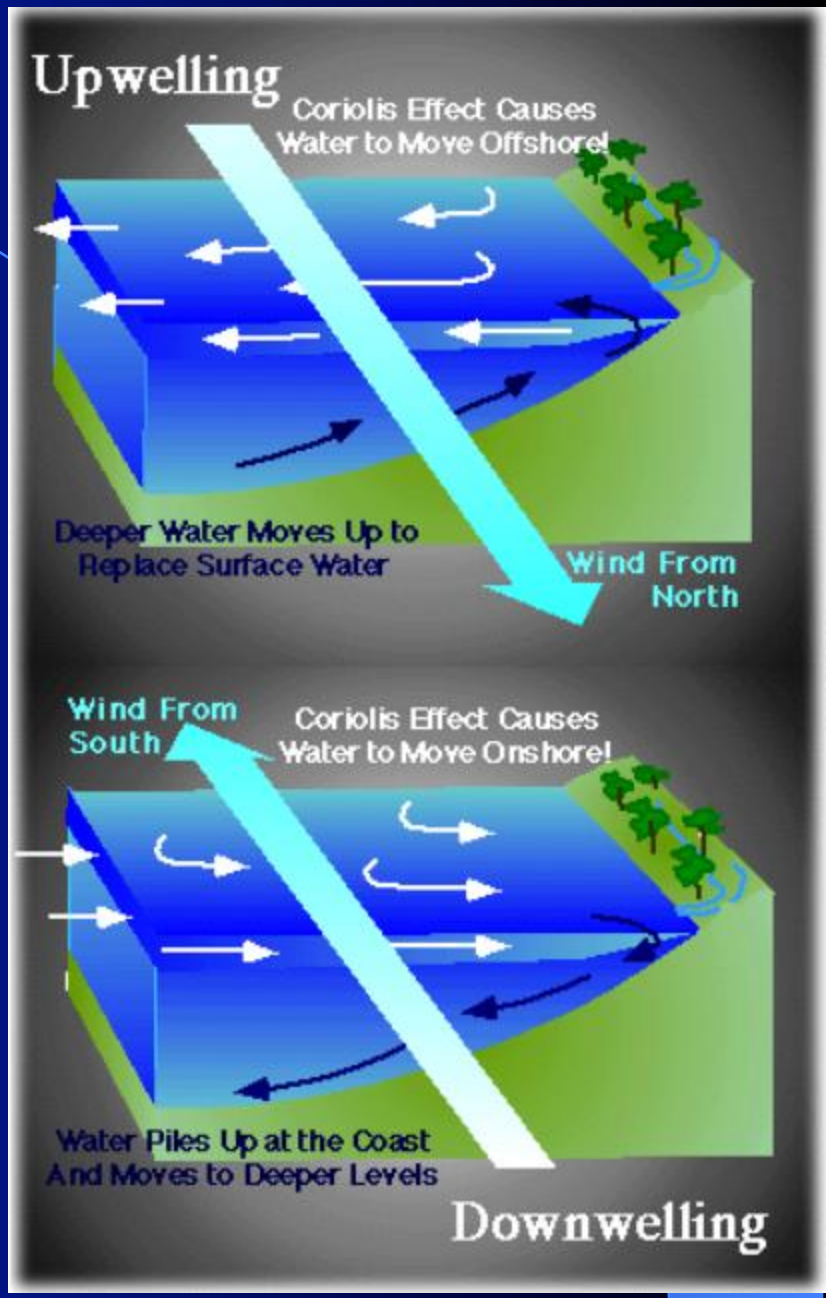
Circulation of Warm and Cool Ocean Waters has a Moderating Effect on Coastal Cities





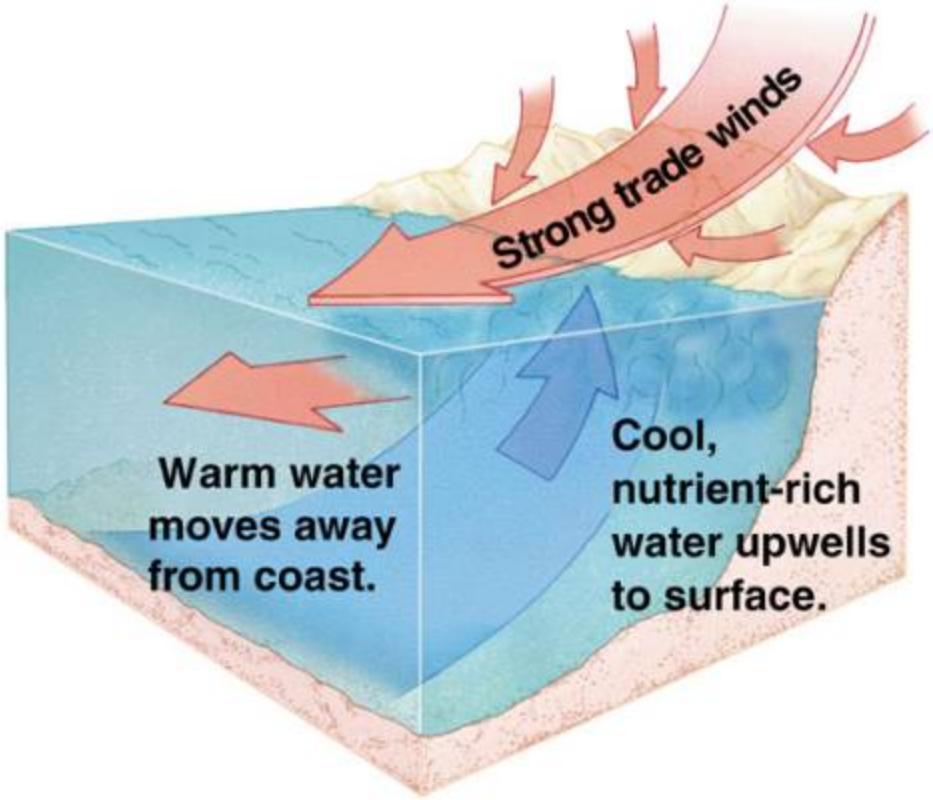
Effects of Upwelling and Downwelling on Currents

When the wind blows parallel to a Northern Hemisphere coastline and the ocean is to the right of the wind direction, upwelling can result. Wind in the opposite direction produces downwelling.



Upwellings Bring Nutrients to Surface

Raven/Berg, Environment, 3/e
Figure 6.17



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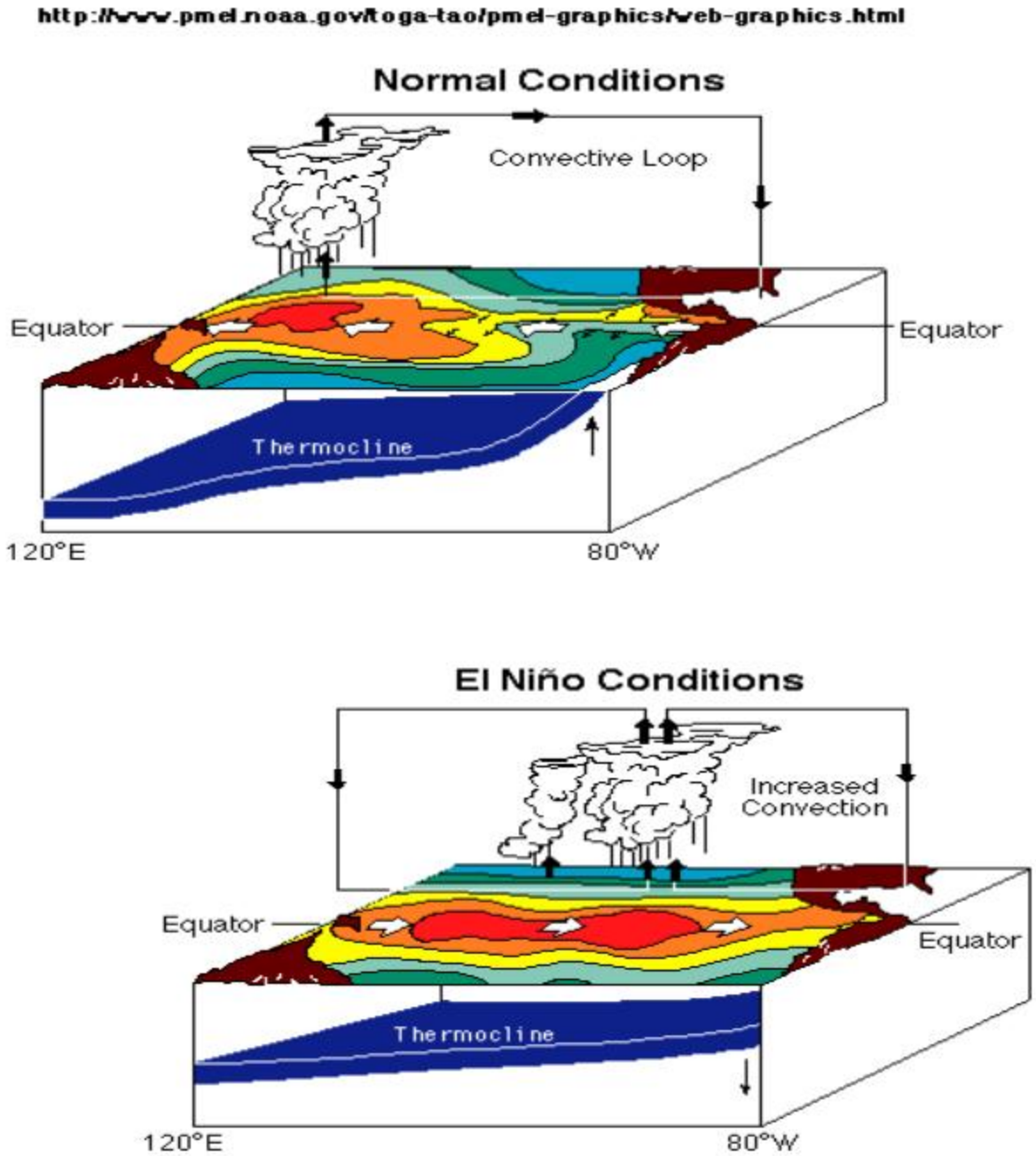
ENSO (El Niño – Southern Oscillation)

The Southern oscillation is a phenomenon that refers to the see-saw effect of surface air pressures in the Eastern and Western Pacific Ocean. For Example, when air pressure recordings are high in Tahiti, they are low in Eastern Australia.

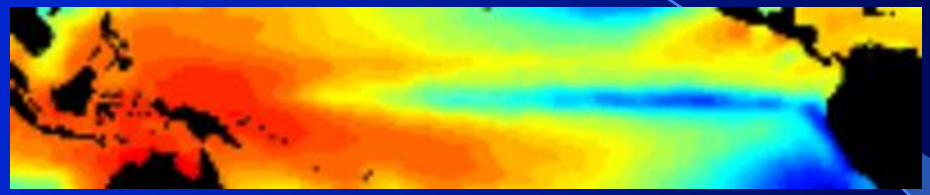
Also noted was a cycle of varying Pacific Ocean temperatures which occurs annually on a small scale. This was recognized by Peruvian fishermen who called it El Niño (Christ Child) because it occurred during the winter close to Christmas.

Normally, have warm waters and heavy precipitation in the western Pacific.

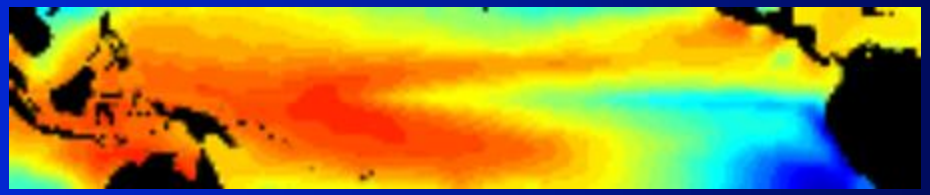
El Niño, have warm waters migrate to the eastern Pacific along with the convective cell and increased rainfall.



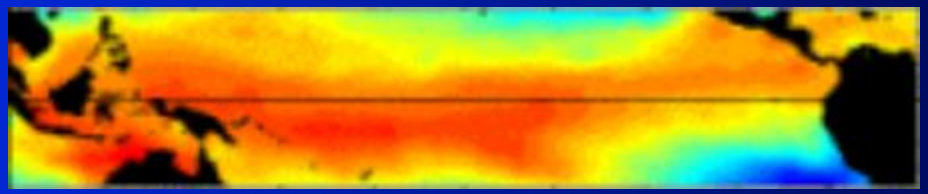
El Niño and La Niña



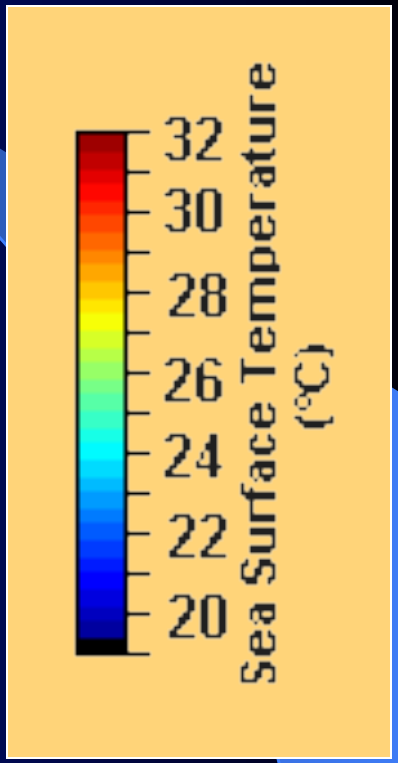
La Niña (cold conditions)



Normal Conditions

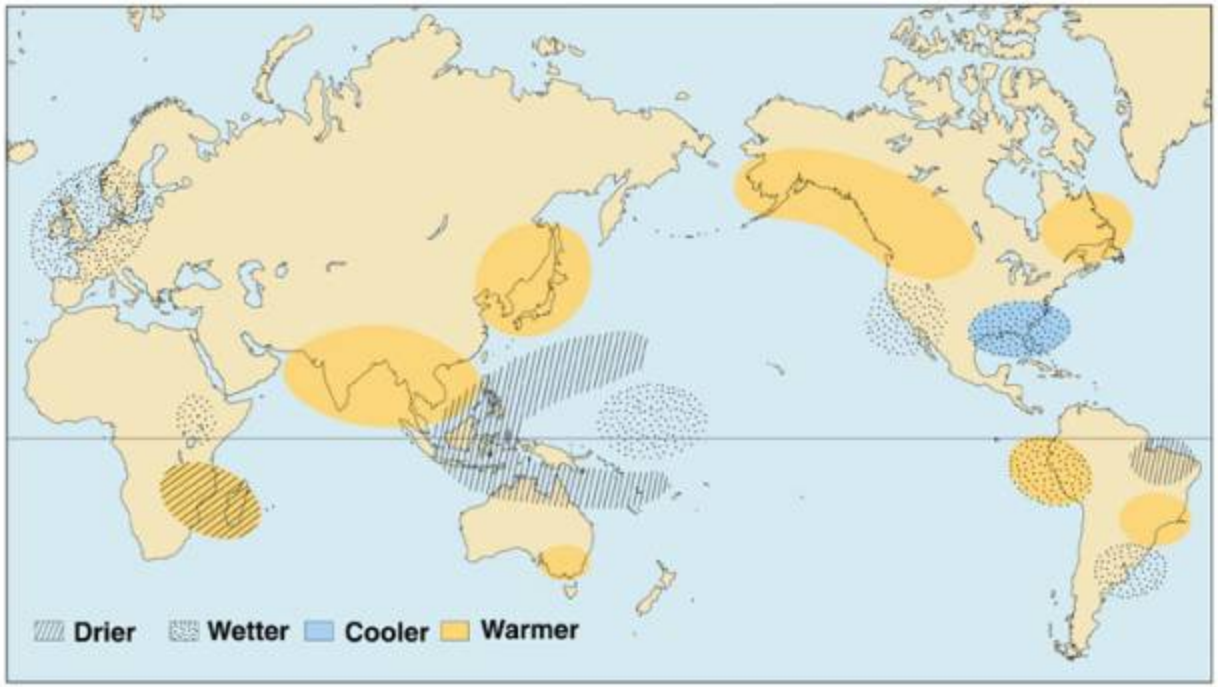


El Niño (warm conditions)



Climate Changes Associated with ENSO (El Nino in the media)

Raven/Berg, Environment, 3/e
Figure 6.16



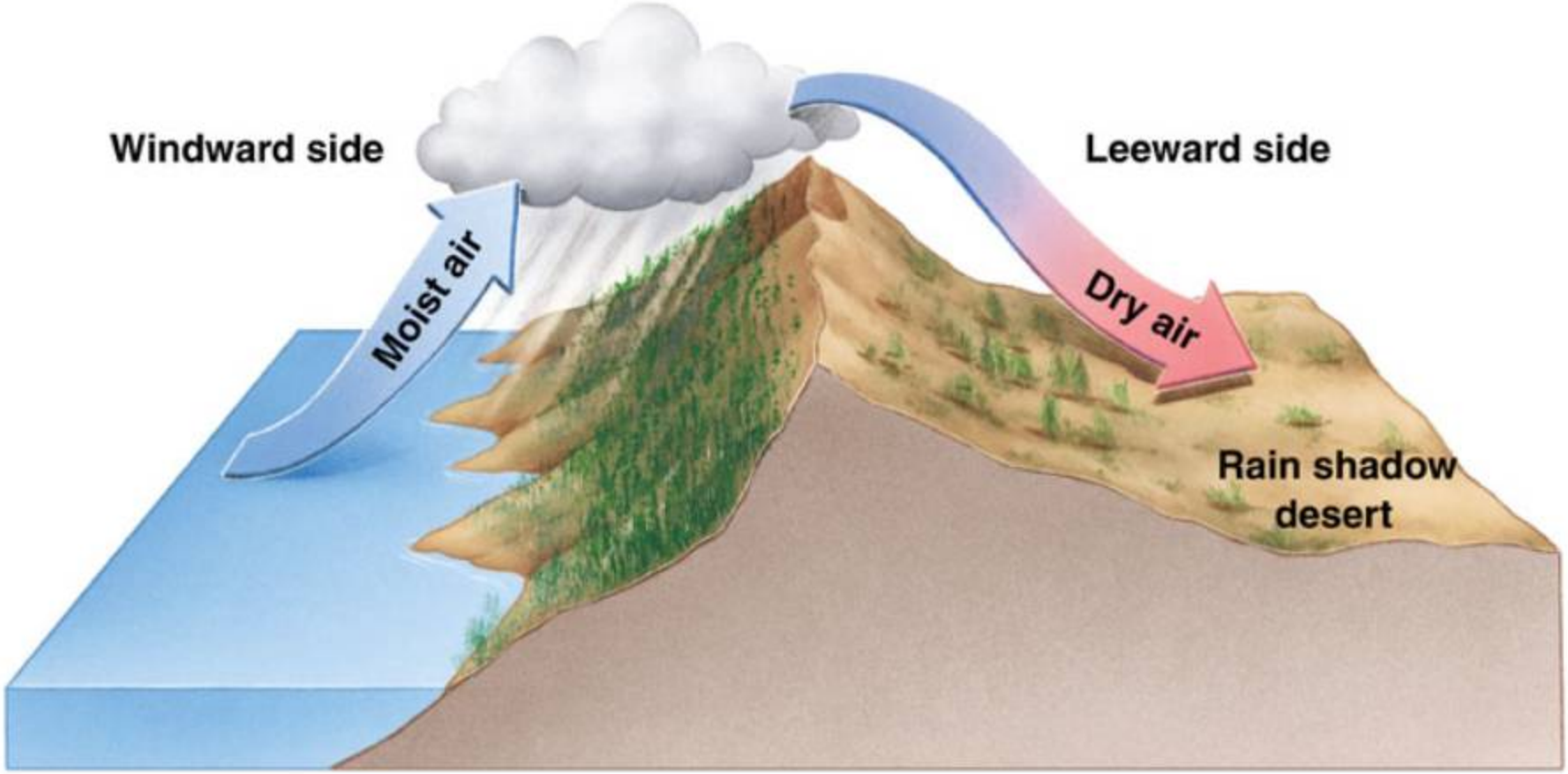
Harcourt, Inc.

http://proa.accuweather.com/www/phoenix2/includes/professional/misc/misc-sst.htm

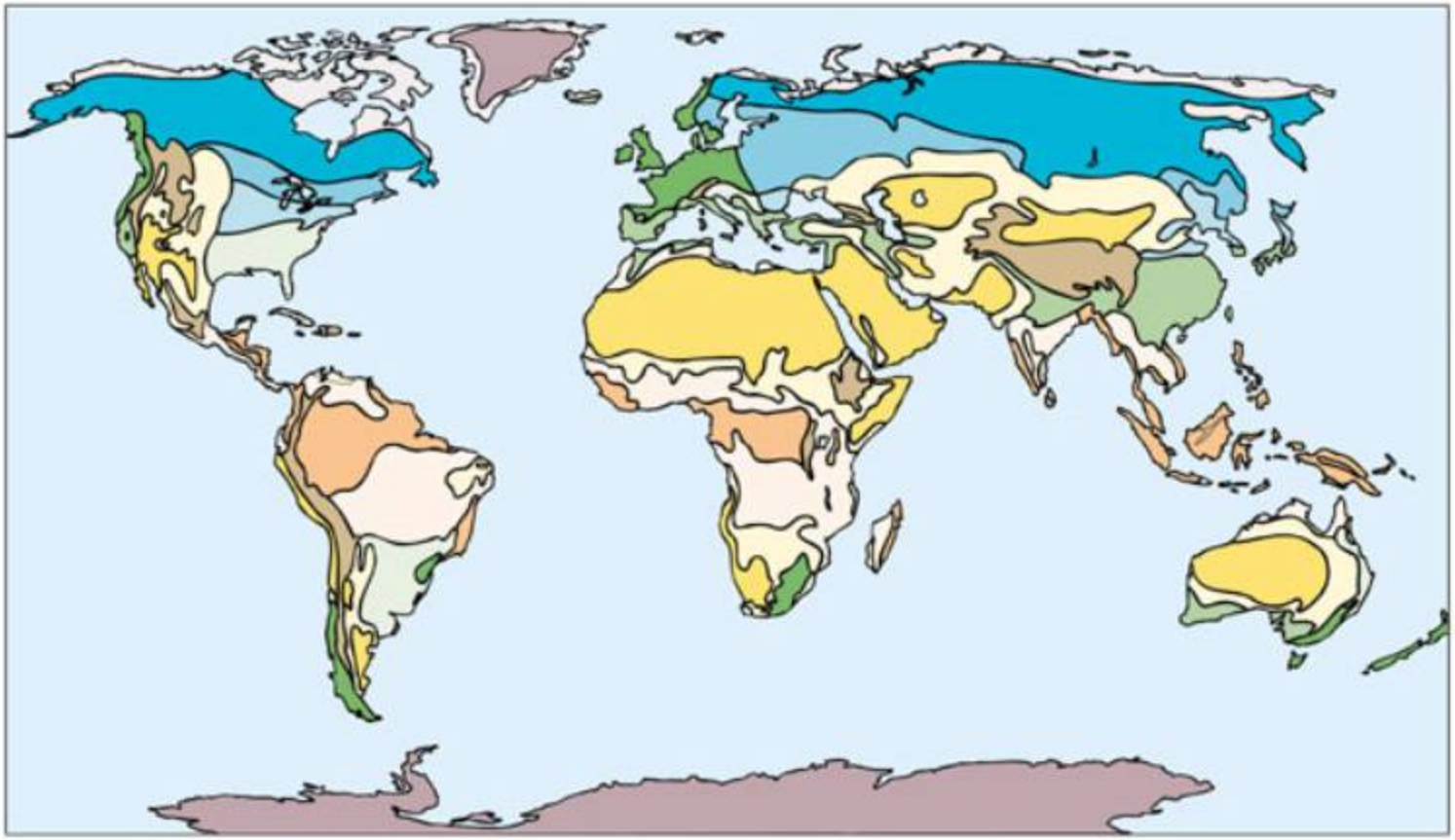
Weather Phenomenon are Produced by the Circulation of Air and Water.

Thunderstorms
Hurricanes
Tornadoes
Droughts
Floods

Mountain Effects on Precipitation



Six Climate Regions



A. Tropical Climates
- Tropical wet
- Tropical wet and dry

B. Dry Climates
- Semiarid
- Arid

C. Mild Climates
- Mediterranean
- Humid subtropical
- Marine west coast

D. Continental Climates
- Warm summer
- Cool summer
- Subarctic

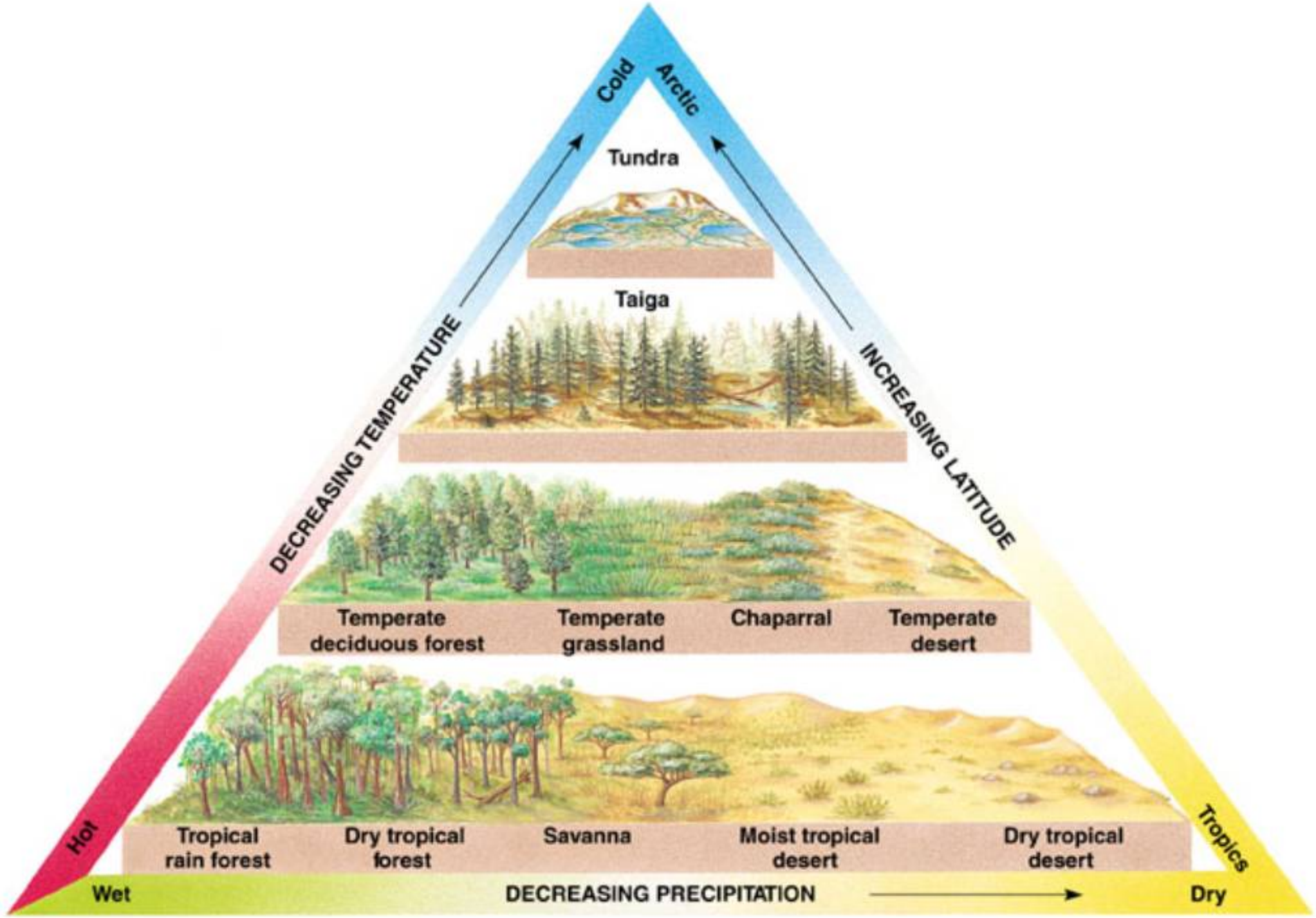
E. Polar Climates
- Tundra
- Ice cap

F High Elevations
- Highlands and uplands

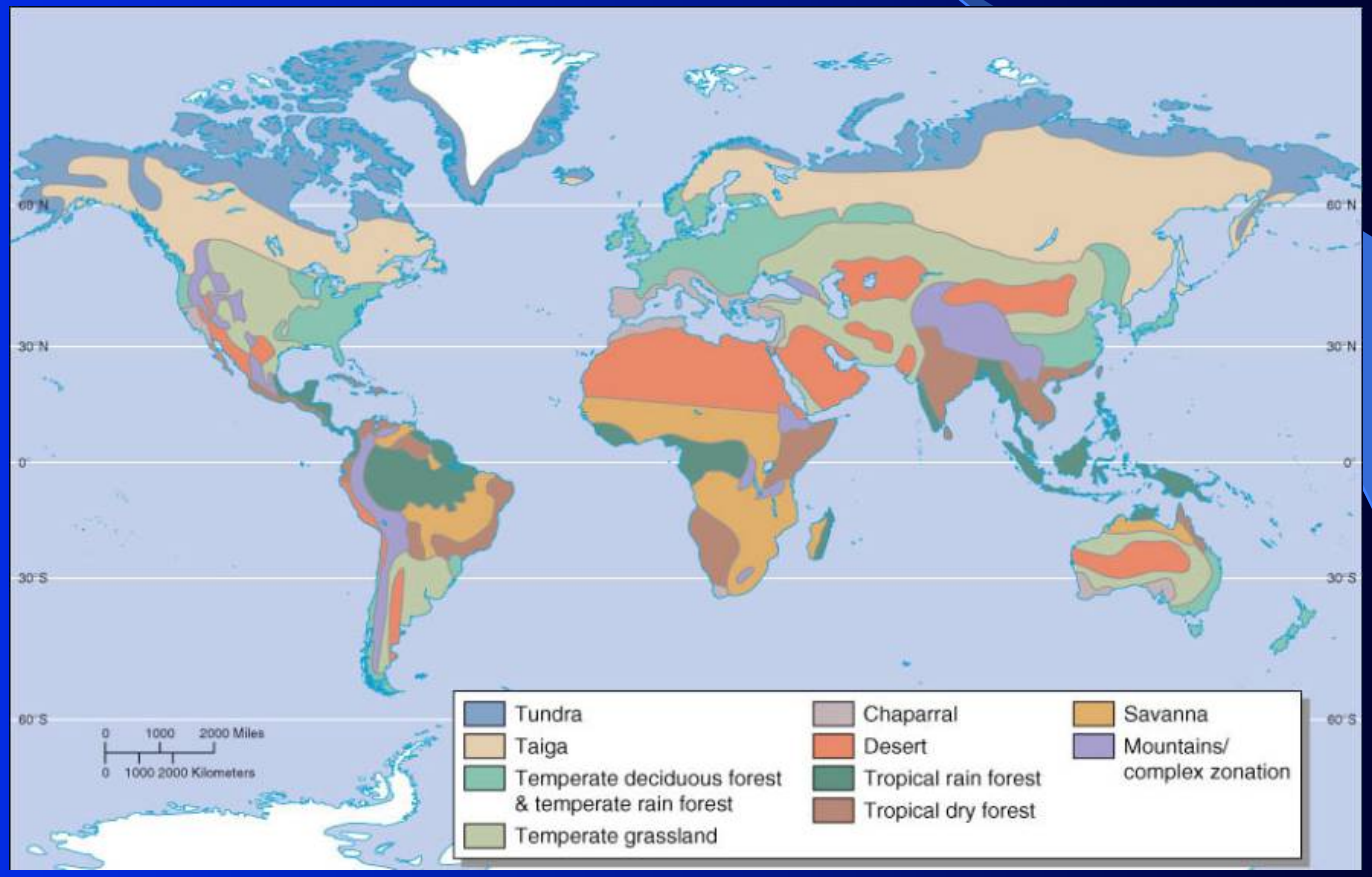
Sliding into ch 8

- Repeated weather patterns → climate
- Climate effects plant growth
- → The biosphere.

- **Major Ecosystems of the World**


Cold
Arctic
Tundra
Taiga
DECREASING TEMPERATURE
INCREASING LATITUDE
Temperate deciduous forest
Temperate grassland
Chaparral
Temperate desert
Tropical rain forest
Dry tropical forest
Savanna
Moist tropical desert
Dry tropical desert
Hot
Tropics
Wet
DECREASING PRECIPITATION
Dry

2 Earth's Major Biomes – related to climatic zones of Chapter 6.

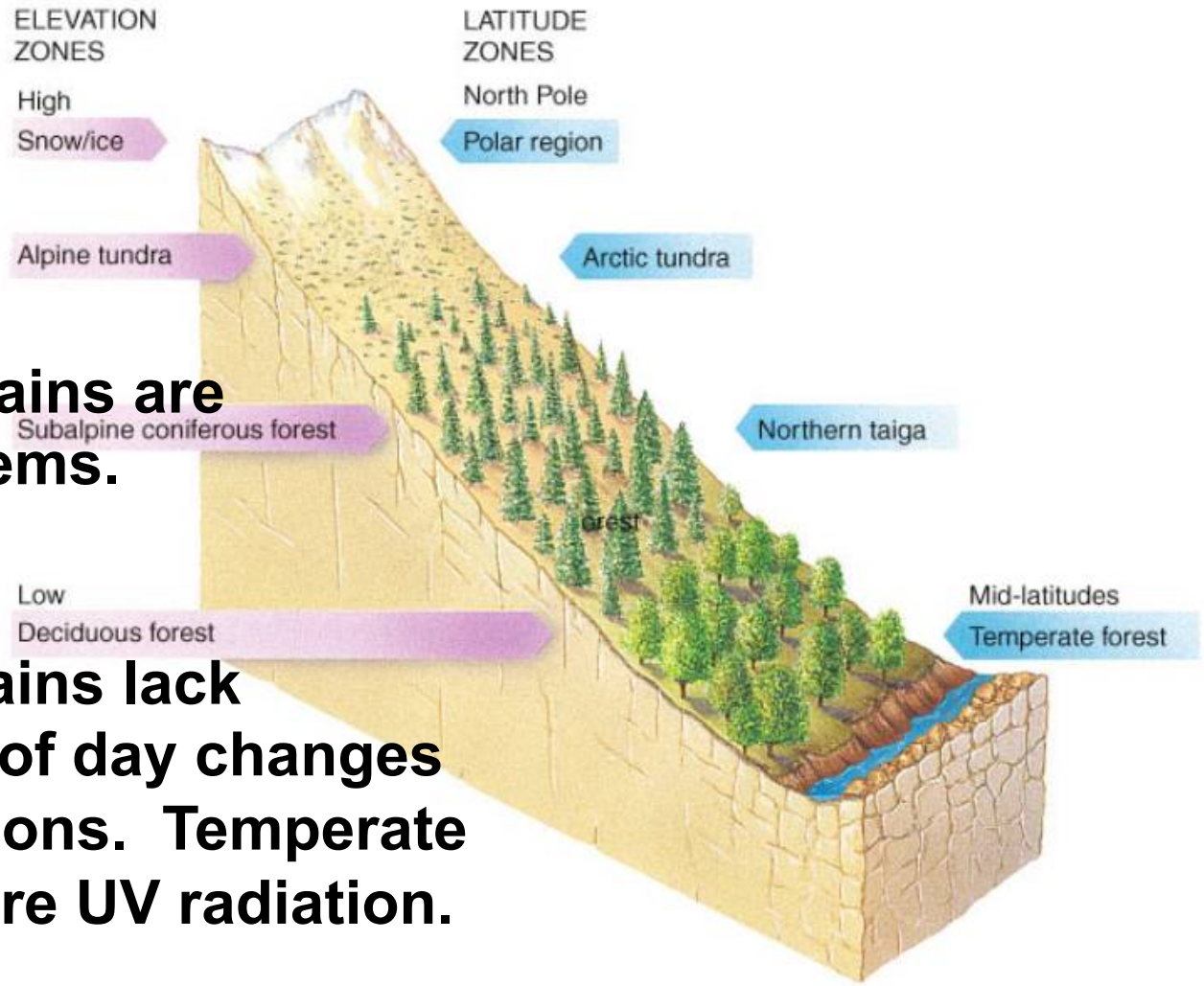


3 Altitude replicates effects of increasing Latitude on large mountains or mt. ranges.

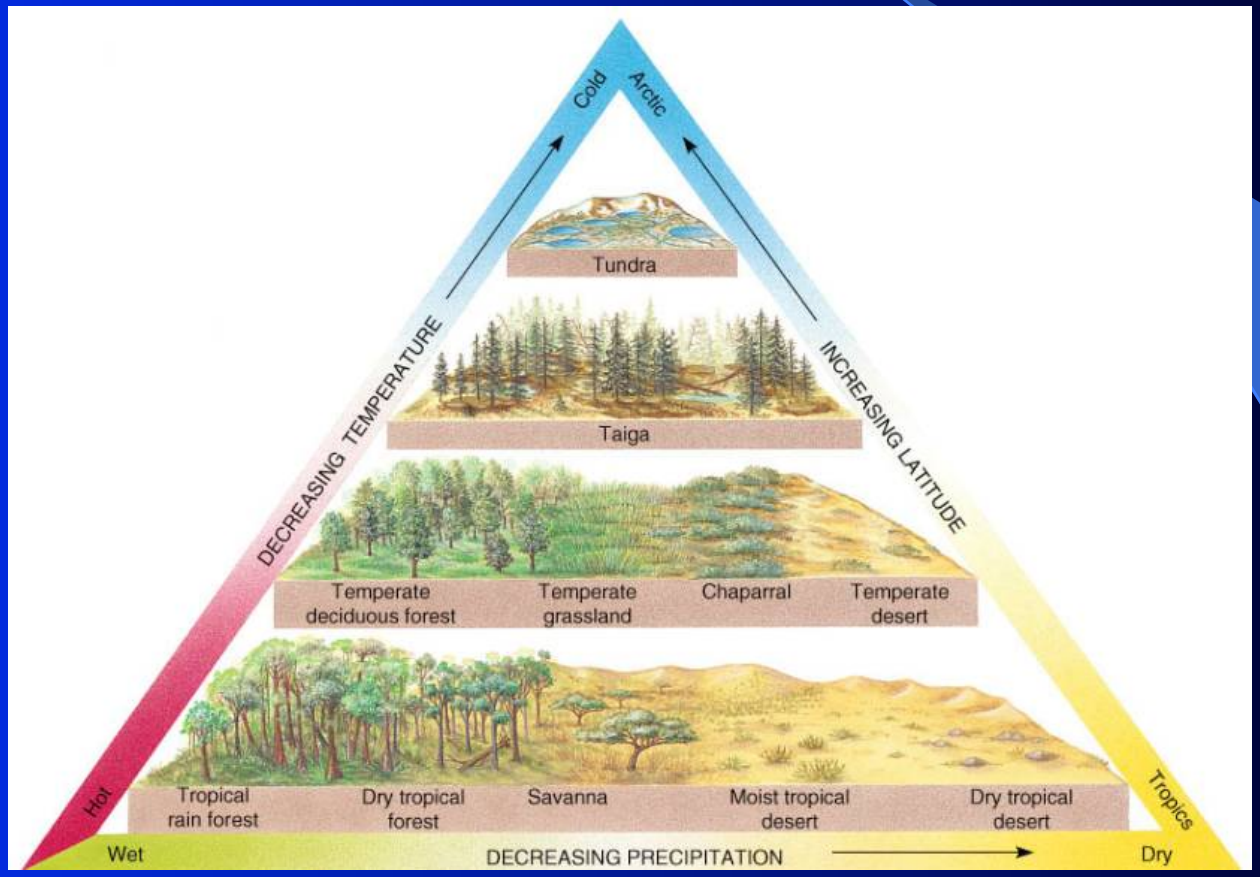
Lacks Permafrost

Individual mountains are isolated ecosystems.

Temperate mountains lack significant length of day changes seen in Arctic regions. Temperate mountains get more UV radiation.



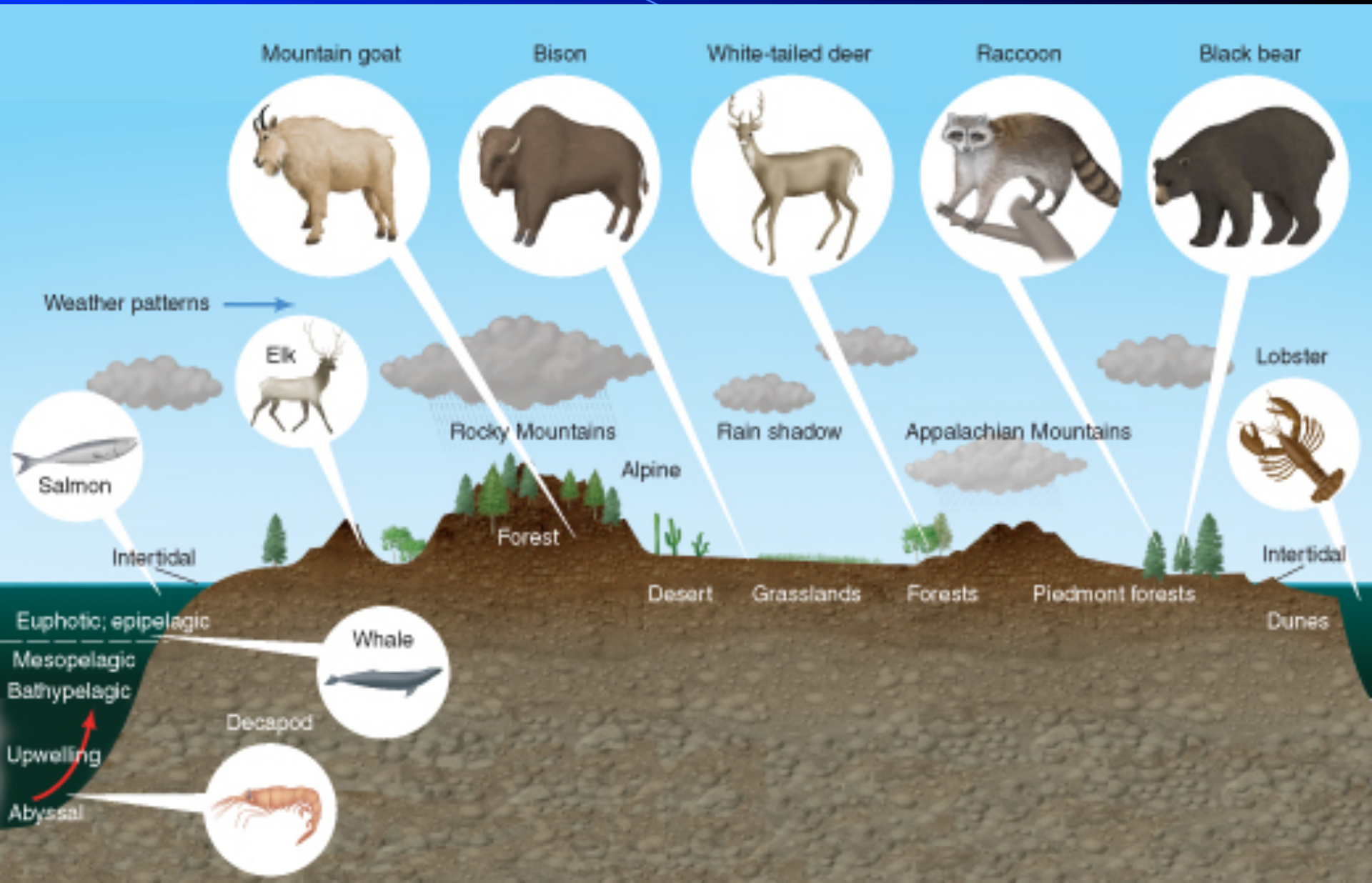
How Temperature/Latitude/Precipitation affect ecosystem locations & types.



A Biome Poem

- It is a large, relatively distinct terrestrial region characterized by similar climate, soil, plants, and animals, regardless of where it occurs in the world.

Animals and Biomes

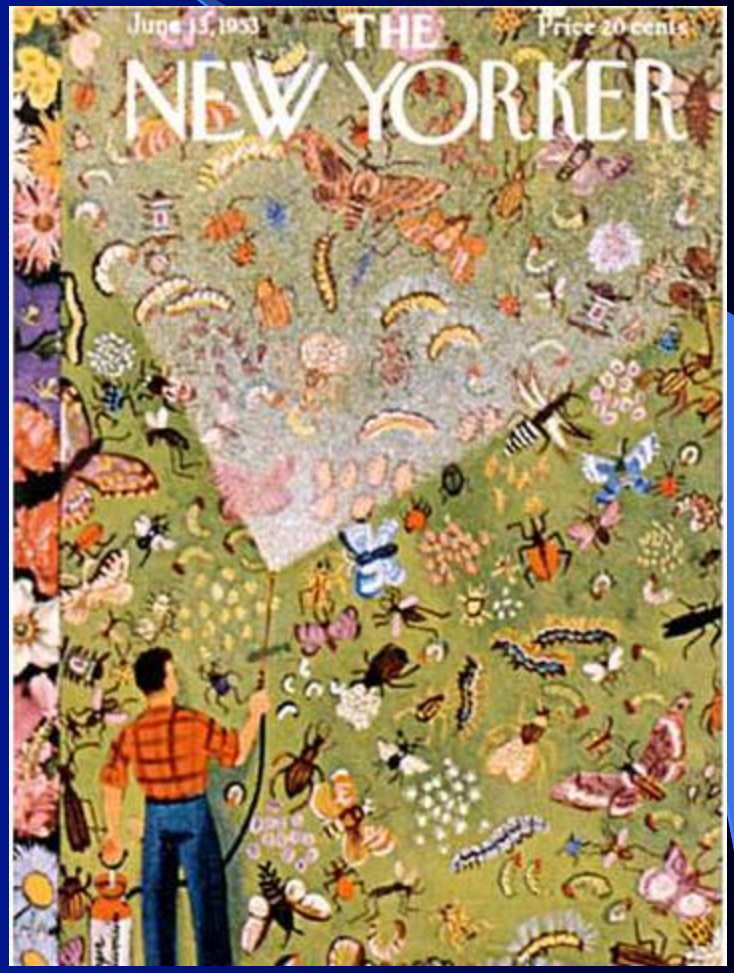


The Importance of Fire

The Role of Fire in Ecosystems -

- **Releases minerals from organic materials.**
- **Removes plant cover, stimulating some seeds.**
- **May trigger erosion & landslides with the removal of root stabilization.**
- **Removes woody plants & trees from grasslands.**
- **Some pine cones require heat to "pop open", releasing seeds for germination.**

What's bugging you? Chapter ? Pesticides



What is a pesticide?

- A pest is something that bothers you.
- It *may* not be something that is a pest to other species (birds like mosquitoes!)
- Insecticides kill insects
- Herbicides hill plants
- Fungicides kill fungi
- Rodenticides kill rodents (rats, mice)

"Don't kill it! That mosquito is carrying my DNA."

Pesticides, the next generation

- 1st generation pesticides are derived from plants that have been fighting pests from the beginning. They are modified forms of plant compounds
- 2nd generation pesticides are synthetic poisons – DDT (dichlorodiphenyltrichloroethane)
  - 20,000 registered commercial pesticides
  - 675 active ingredients

The dark side

- DDT- banned from US use in 1972, eggshell thinning, highly toxic to aquatic life, accumulates in the biosphere
- Agent Orange – Vietnam – defoliation → dioxins = soft tissue cancer causing agent, birth defects for generations,

Temek

- In the summer of 1985, nearly 1,000 people in several Western states and Canada were poisoned by residues of the pesticide Temik in watermelons. Within two to twelve hours after eating the contaminated watermelons, people experienced nausea, vomiting, blurred vision, muscle weakness and other symptoms. Fortunately, no one died, though some of the victims were gravely ill. Reports included grand mal seizures, cardiac irregularities, a number of hospitalizations, and at least two stillbirths following maternal illness.

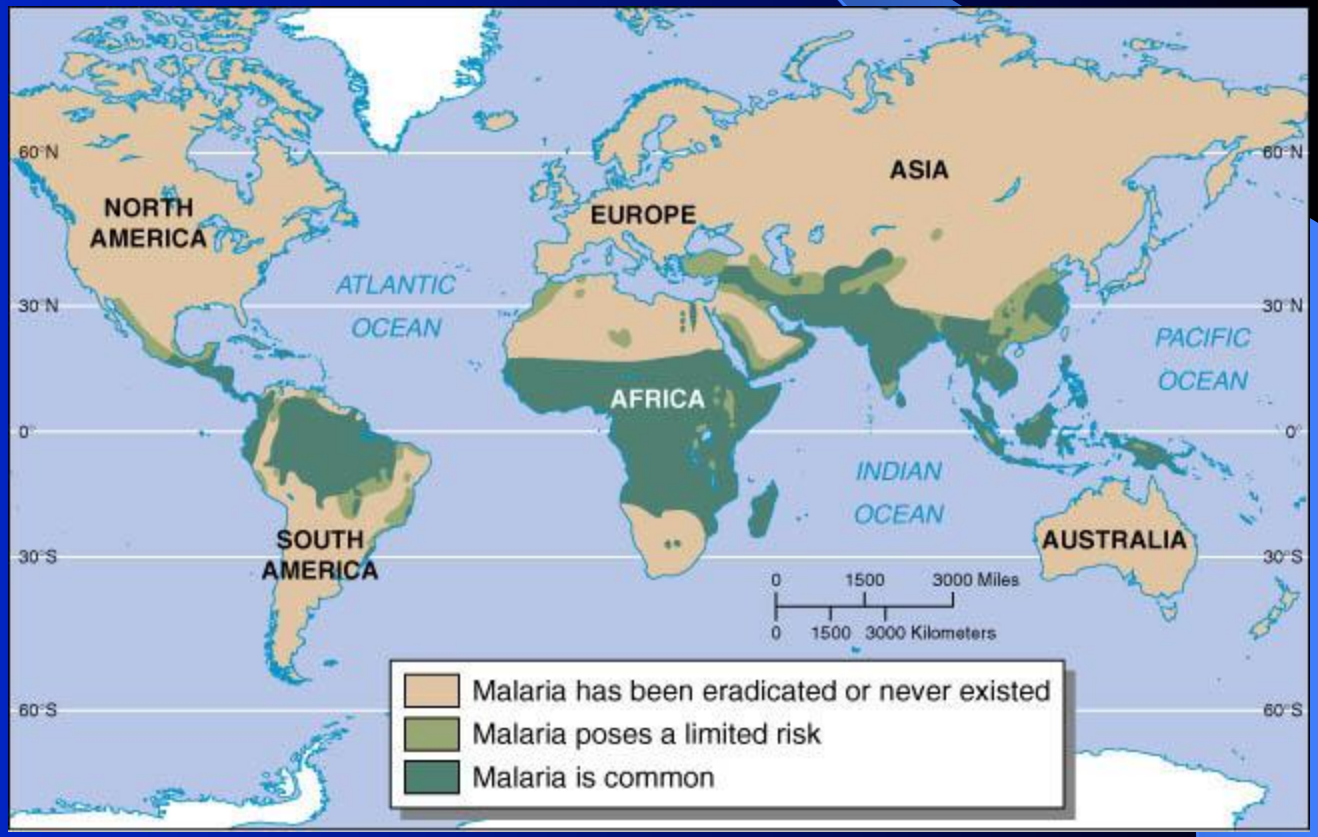
Apples and Milk

- During 1986, the public grew increasingly concerned over the use of the plant growth regulator daminozide (Alar) on apples **(based on flawed interpretation of 1977 rat studies).** Primarily used to make the harvest easier and the apples redder, Alar leaves residues in both apple juice and applesauce. **Possibly more harmful chemicals are now in use.**
- Also in 1986, approximately 140 dairy herds in Arkansas, Oklahoma, and Missouri were quarantined due to contamination by the banned pesticide heptachlor. Dairy products in eight states were subject to recall. Some milk contained heptachlor in amounts as much as seven times the acceptable level. Those responsible for the contamination (gasohol grain mash was fed to cattle) were sentenced to prison terms. **This and an accidental contamination on one of the Hawaiian islands did not result in an increase in birth defects of childhood cancers.**

"Pass it along. Apples are back."

The good side

- Disease Control – Malaria
- (Remember Global Warming)

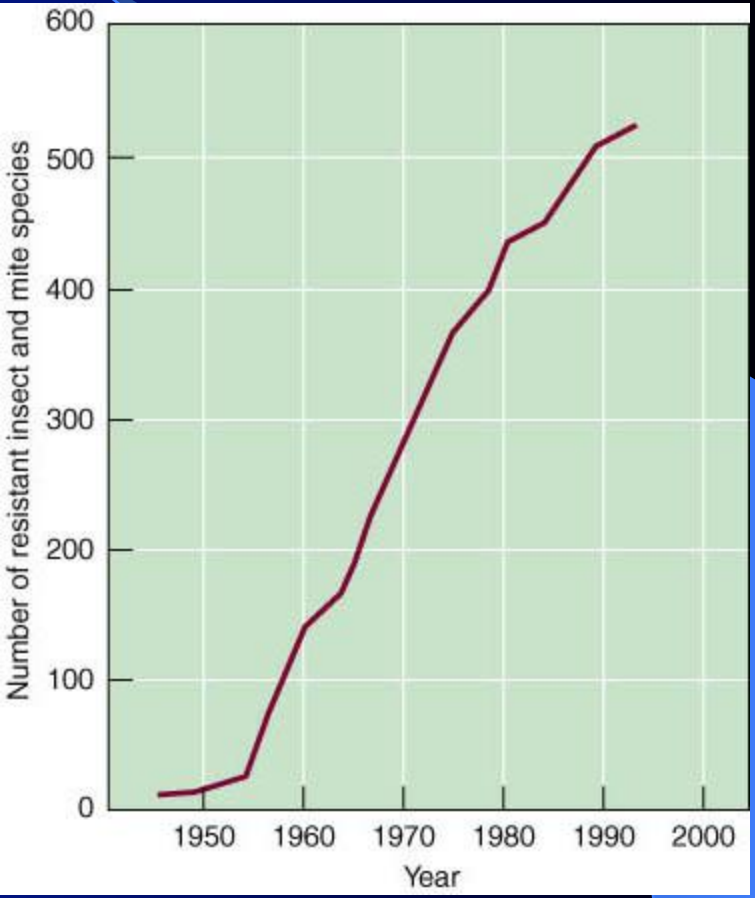


Crop Protection

- Most efficient = monoculture (one variety of one crop over a vast area)
- Pests and weeds can seriously decrease production

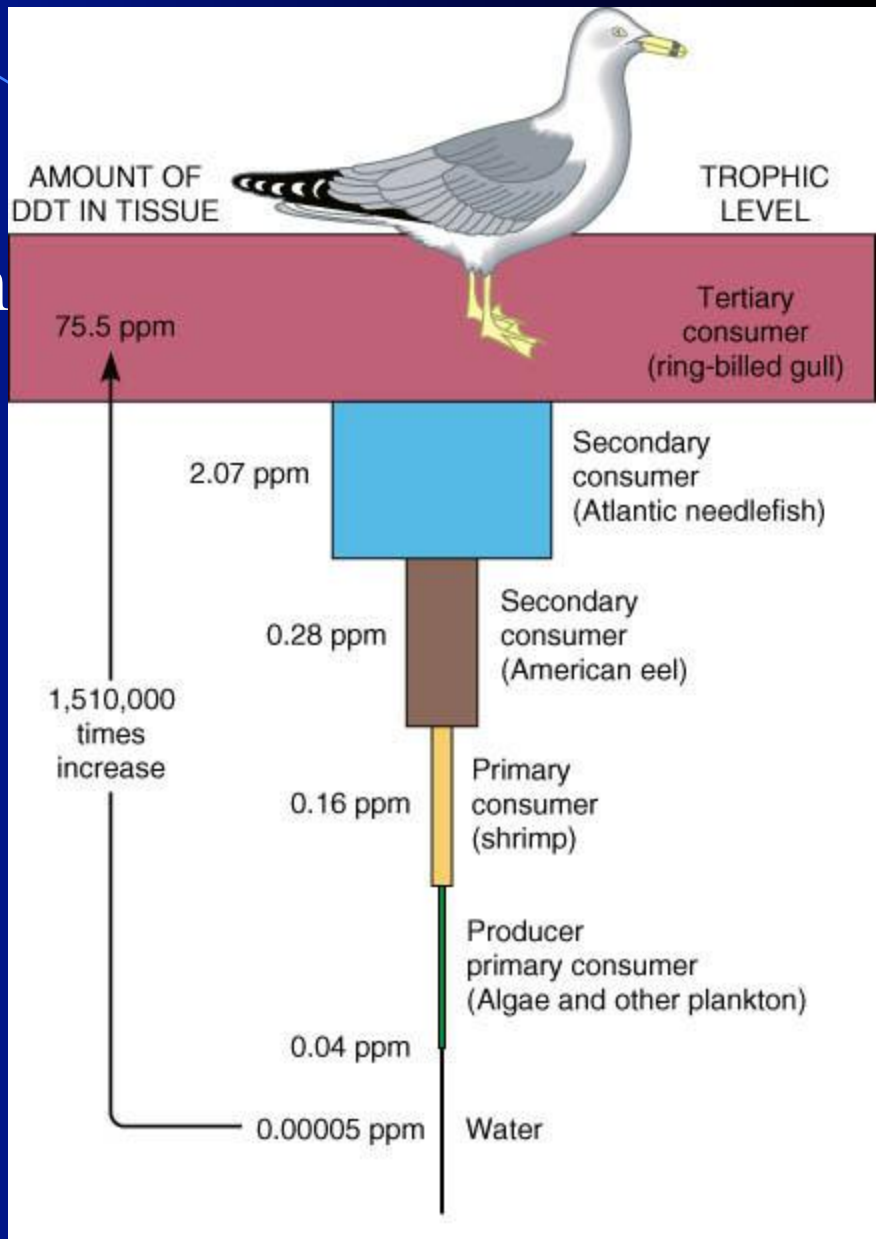
Unforeseen Consequences

- Genetic resistance.
- What does not kill you makes you stronger… as a species.
- At least 520 species of insects and mites have evolved resistance to certain pesticides
- (Similar to improper use of antibiotics and antibacterial soaps/creams)



Bioconcentration

- Each ‘higher’ life form eats many of the ‘lower’ life forms over years. If the pesticide can accumulate, it does, rapidly, as you get to the larger creatures.



Alternatives

- Cultivation methods – interplanting of plants that attract beneficial insects or repel harmful insects
- Use naturally occurring disease organism, parasites or predators to control pests.
- Pheromones (lure pests to traps)and Hormones (disrupt pest life cycles)
- Reproductive control – release sterile males
- Genetic control – develop crops that are more resistant.

Risk again…

- The bottom line:

1. These poisons ‘can’ build in the environment or living organisms and harm us.
2. These poisons kill diseases and pests that decrease the quality and quantity of food.
3. They should be analyzed on a case by case (-cide by –cide) basis.
4. The cost to the environment and us VS. the benefit of controlling the pest/disease in question.

Team Work 7:30pm-ish

- Invasion of Planet Earth!

- Look up invasive species on the internet and pick one to research for 5-10 minutes
- Research and estimate the risk of this plant/animal/ fungi etc. invading Colorado
- Present the history of this species, its invasive nature, $ spent holding it back and its threat to Colorado and what we may do to protect the state if it is not too late.

Team Work 8:30pm-ish

The Nitrogen Cycle

- Divide into your learning team.
- Each group will read "Human Alteration of the Global Nitrogen Cycle: Sources and Consequences" (shorter but a bit more technical) or "Human Alteration of the Global Nitrogen Cycle: Causes and Consequences" (longer but a bit easier to read) Posted in the OLS

– After each group has read the critical thinking issue, develop a list of ways human activities might be adapted to decrease human contributions to the nitrogen cycle.

– Teams: nominate someone to share your list in class.

Team Work 9:30pm-ish

- Living and Nonliving
  - Divide into learning teams.
  - Ask each group what the following statement means: "Any living or life-containing system is always more ordered than its nonliving environment."
  - Instruct students to discuss, in their groups, what they think the statement means.
  - Instruct groups to share their thoughts with the class.
  - Answer questions like: What is life? What is a prion? What is a virus? What about artificial intelligence – will we call it alive? How does that statement pertain to prions to AI?

Next Chapters

- Resource Management: Putting it all together…
- Ch 10-13 (not 14,15) & 19-21